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(J. A. BERLY'S).

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BOILER REFORMATION.

DR. NICOLSON has set forth to reform the steam boiler, and he builds his practice on what appears to be to him a new discovery, but has long been known to steam engineers, namely, that hot gases part with their heat to boiler surfaces more quickly as they travel more quickly. But engineers have hitherto been content with such a rate of travel as could be given by natural draught without reducing too far the rate of fuel combustion per unit of grate area. Not so Dr. Nicolson, for he must hurry the gases along by *force majeure*, and not content himself with Nature's easy-going differences. He knows quite well that hurrying the gas means power expenditure, but this troubles him not, for he looks to get it all, and more, back in increased efficiency and reduced cost. We cannot see much in increased efficiency. An ordinary boiler will give 80 per cent. Tests have been published by another Doctor showing 86 per cent., but we withhold our credence from anything over 80. It annoys Dr. Nicolson that boilers have been designed by trial and error, and not by high mathematics. Yet his own first boiler was a failure. We wonder if the next one, which also appears to have been unsatisfactory, was any more mathematically correct. The *Engineer* plainly tells the Doctor he does not know boilers, and scoffs at the idea that German mathematics have produced anything so good as English boilers.

Dr. Nicolson aims at small heating surfaces intensely heated. Practical men know the difficulties which attend on such. Dr. Nicolson hopes to overcome them by forced currents through his tubes at, of course, an expenditure of power. Well, he may succeed, but we much fear that a study of the somewhat simple equations of chemical actions would discover difficulties that have not been covered by his mathematics. The learned doctor appears to think that we lag behind Germany because we are not always deeply engaged in high research. This, to our mind, is not true. It is often urged that we lost the coal-tar industry; but this was because we neglected to apply an Englishman's discovery. It had nothing to do with any lack of English scientific knowledge. The man who conceived the idea of using blast-furnace gas in engines was no mathematician; but his ideas were scoffed at by scientific Continental engineers, whose theoretical knowledge led them to insist that the gas should be used *uncleaned*. They only made a practical success when they adopted the inventor's practice of cleaning the gas. This industry owes nothing to theory, and the German gas engine is a product of trial and error. As the *Engineer* points out, Germany has nothing to show in boilers that is better than English practice, and our contemporary asks for nothing more than definite proof that Germany can show better boilers, and that such betterment has its rise in mathematical investigation.

It does not appear to occur to Dr. Nicolson that boiler design has necessarily had as a bounding factor the question of the solubility of lime and other salts. This has always exerted a profound influence on design and economy, and is one of those factors which put all theory to flight.

Is not Dr. Nicolson treading already explored territory? Probably all he suggests has been carried out, and much of it, may we say, deposited with the scale. A steam boiler, as it exists in practice, is very much the result of a full combination of every possible theory.

But most of the theories were unknown factors only to be solved by trial and error. The present-day boiler is the solution. Given, say, an assured soft water, and there might be made many changes. May we suggest to Dr. Nicolson that a thorough study of the salts of barium and their *cheap* production might enable all boilers to use soft water. At present the barium salts are expensive in two senses. They cost a good deal per pound, and they have a very high molecular weight, and are, therefore, of small efficiency per unit of weight. They may, perhaps, be produced electrolytically. They are very poisonous, but that does not seem to count much in an insoluble salt. They do not need measuring out to a feed water. They need to be there, and the feed will take what it requires. It seems to us that here is a question which permits of a lot of useful scientific research that might produce results of far greater value than the multiplication of boiler-house machinery such as the Nicolson ideas demand. When the barium studies have borne good and useful fruit, the steam boiler will vary in accordance by the natural processes of commercial selection. It is an ungrateful task to discourage an enthusiast, but of late years Manchester seems to have started several wrong hares. Was there not the denial of cylinder condensation effects, which Hirn did so much to establish after the Englishman Clark had pointed them out?

Hirn was a thinking Continental engineer, and we rather think that Dr. Nicolson was not unconnected with the school which sought to refute his views, with as little success as has attached to the boiler crusade. Let us think by all means, but has Dr. Nicolson had enough of boiler experience to think correctly, or to apply these principles of high velocity to a commercially-practicable design?

BRITISH PRESTIGE AT HOME AND ABROAD.

The nationality of the engineer empowered to give out contracts, or to specify particular makes or designs of machinery and apparatus—how far is this a factor in deciding whither orders shall go? It used to be openly said that a fair amount of electrical business from India, and electrical and mining work for South Africa, went either to the United States or to Germany, for this reason. Americans in Australia and Canada were not free from charges of predilection for U.S.A. manufactures, nor are they now. But Germany profits very largely still from business on the Rand, though there are some English engineers at the fountain head and many lower down the stream. There are, of course, other reasons in this particular neighbourhood, as there always have been ever since the first German power station was put down in the vicinity by a British company with foreign directors, but we suspect that at the root of such considerations as finance, machinery suitability, and appropriate electrical experience, there may also be found this nationality question, which expresses itself in the shape of a definite and practical interest in the development of German electrical manufacturing industry. The American and the German, then, may be said to introduce their own country's manufactures wherever there is a chance, though, personally, they may not be attached to any particular manufacturer, but are occupying professional positions in which they are presumed to be free to adopt whatever goods satisfy their requirements as to price, time, and general suitability.

There are not many foreigners in the British Isles who are placed in positions where they can afford to ignore the excellence of British machinery and the figures in British tenders. We venture to believe that the foreign manufactures that have come into the country at their dictation during the past five years or so have been comparatively small. On the other hand, it has been repeatedly pointed out that there have been a number of cases during the same period in which British engineers having the power of recommendation, and practically the final voice in settling the course of contracts, have been perfectly free from pro-British bias. No doubt in each such case they were able to advance special reasons, appropriate to the matter in hand, which had weighed with them in arriving at a decision to pass by their own kinsmen's manufactures. We are not here attempting to inquire into the *pros* and *cons* of individual instances of the kind; we are merely remembering the tendency—individual cases have been discussed as they have arisen at different periods.

We have then, speaking broadly, come to the conclusion that a German cannot often be suspected of a willingness, let alone the desire, to place orders in England, but that the Englishman is not always credited with showing an over-zealous regard for the electrical manufacturing activity of the nation of which he forms a part.

We may, we hope, mention this circumstance, observed from the evidence that has passed before us, without any of our readers accusing us of an advocacy of unfair preference being exercised in favour of the British manufacturer. If an engineer really cannot procure what he must have for his system at a reasonable price, in a reasonable time, from a British works, he must of course get it where he can.

When discussing foreign markets it has often been felt that the ability of the British manufacturer in the production of electrical machinery of all kinds has not been made known as it should have been. It has seemed that the absence of accurate knowledge on this point has been accompanied by a bias, in some cases in high places abroad, against British products, because British electrical manufacturers have been thought to be behind in the running. The dissemination of the truth of the matter has done something to recover the lost ground and to re-establish British electrical prestige, but the bias still remains in places. The full cause of it is sometimes difficult, or even impossible, to ascertain; where it is possible to ascertain it, one can seldom describe it with sufficient accuracy and force at this distance from the sphere of operations. We wish well, however, to the efforts of all, whether as

organisations or as individuals, who are trying to remove prejudice from the minds of men of influence and authority, concerning the price and quality of British manufactures, the ability of British manufacturers, and the honour and soundness of those responsible for the conduct of our industry. So long, however, as English engineers practising in the United Kingdom showed what some thought to be undue favour to foreign manufacturers, there was a measure of justification for engineers abroad imagining that their bias against us was not wrong. They would only know the fact; with the train of circumstances leading up to, or surrounding, that fact, they might be quite unfamiliar.

We are not concerned in this article with the amount of business that we are losing because of the financial arrangements that our competitors are making, such as concession securing at high prices from previous owners, with extensions of considerations which assure them almost a monopoly of electrical business coming on to their circuits. Nor are we particularly concerned at the moment with the movement in the direction of longer credits, which really amounts to money-lending, or investments at so much per cent. interest on the unpaid balances, though, parenthetically, we may remark that there seems to be little difference between buying shares and bonds which return a sure 5 per cent., and sending plant, the cost of which (with a good profit included) remains in the hands of the plant buyer, it may be a public department or a well-established concern of repute, on loan, with a sufficient security handed over against it. In the case of the shares and bonds, the investor carries the advantages and the disadvantages of rising or falling market values, the plant-seller on the money-lending system does not do so. In the case of the plant-seller, his accommodation brings him the return in interest that it costs him to raise the money, but he also secures a hold for future electrical business, perhaps on the same or better terms if his manufactures have met the buyers' needs. It naturally requires a good deal of capital to enable one to go far in transactions of this sort, but if the security given is all right, the banks should bear the burden in the ordinary course of their business. If the security is not sound, well, the plant supplier has to bear the brunt of eventualities, and time will tell the wisdom or otherwise of deferring payments over one, two, or even six years, which periods, according to notes appearing elsewhere in this issue, some of our German friends are allowing for payment for certain classes of manufactures.

This new practice is no doubt assisting German export trade at the present time, but we are doing well ourselves in that direction, are increasing our hold upon important markets, are letting the world know that British electrical industry possesses a very real vitality, and we shall gain as time passes.

As we judge it, British electrical manufactures never stood higher, and were never produced at so low a figure, as now, and as we maintain this state of things, or effect still further improvements in the same directions, so should our dependence upon foreign factories continue to diminish, assuming that fair-play has a place in the business code of our foreign competitors.

We observe with great satisfaction that British electrical engineers in South Africa are gaining for themselves the same reputation that the American and the German used to have in that and some other Colonial markets, namely, they desire to use the manufactures of their own mother country. Most men ought by nature to have a preference for the manufactures of their own country. We cannot reasonably object to the foreigner who, after securing a position of responsibility abroad, remembers "the old folks at home" in a practical manner when opportunity offers. And nowadays, with so many English electrical engineers leaving for foreign service every month, we should have a growing number of friends at court abroad. But we have to remember, too, the increasing activities of German travellers, and engineers armed with full authority, in most of the world's markets. The Johannesburg U.S. Consul has recently pointed out that American-made electric light supplies do not, in general, meet with favour from British engineers, it being said that small fittings are generally not so well made as the British and Continental product. Furthermore, a number of American lines show such wide differences from English practice that they are not acceptable, even if as well made. "Local engineers' specifications are being framed on British practice," and American standard voltages and frequencies are not in accord therewith. Some of the larger American firms are understood to have found it to answer their purpose to cater specially for this British-practice class of business, especially in motors and switchgear.

Another interesting point brought out by this Consul relates to the probable course of telephone business in South Africa under the new Union Government. It is understood that whereas in the past it has been the practice of the several Governments to place their orders for telephones and telephone supplies through the Agents-General in London, this custom will in future be discontinued wholly, or in part, and that more tenders will be called for publicly. Hitherto, business of this description has gone almost entirely to Sweden. It is stated that the telephone system in Cape Colony is now regarded as obsolete, and that a large amount of reconstruction work will be necessary shortly. The intention to put such matters up to open tender is a fair and correct policy, and it is to be welcomed. No doubt British telephone manufacturers will show their appreciation of this opportunity to the full when it comes along.

Another Limerick Competition.

MANY missing words might there have to be in this article if we were to write in obedience to our first impulse after reading the report of the recent special meeting of the Limerick Council, at which the appointment of borough electrical engineer was discussed and voted upon. Limerick, be it known, is in Ireland, and to suppose that any candidate from benighted England, canny Scotland, or gallant little Wales, could be acceptable as a candidate, any more than a heathen Chinee, only indicates an imagination which takes erratic flights. Limerick needed an electrical engineer to put its house in order; according to the expert report of Mr. A. V. Clayton, it needed one badly, and therefore advertisements were duly issued setting forth a variety of technical qualifications. But it also specified, as it had done on previous occasions when it had wanted an electrical engineer, some general subjects. Did it not add "A knowledge of the Irish language and Irish history on the part of the candidates will be considered an additional qualification"? An additional qualification one would generally regard as

something subsidiary, secondary, or more or less in the nature of an afterthought, the technical qualifications, which were given at elaborate length, being considered of first importance to enable the Corporation to put its electricity works into a decent state and run them efficiently in future. Mr. Clayton, himself an Irishman, like many another from the Emerald Isle has attained to a position of eminence as an electrical engineer, and he ought to know what sort of a chief is needed to rehabilitate a neglected undertaking. He, after the usual study of the merits of the applicants, selected three—all Englishmen—chief among whom he placed Mr. F. Swarbrick, A.M.I.E.E., of Leigh Electricity Works, to whom he gave 100 marks, the other two following with 90 marks and 75 marks respectively, but Mr. Swarbrick was "head and shoulders" above all other applicants, and he was recommended for the appointment. Though Mr. Clayton was stated as one of the elect by nationality, he does not seem to have been allowed to adjudge the merits of the applicants in respect of those additional qualifications, for the Rev. Father Kelly examined the candidates in Irish language and history, and reported that "none of the three selected by the expert had attained to the elementary standard in these subjects." Are we surprised at their deficiency? There were two Irishmen among the candidates, and in Mr. Clayton's estimate they tied for the fourth place in order of merit. Here was the making of a pretty quarrel, and a pretty quarrel it made.

The end of the whole matter for the present is that Mr. Clayton's recommendation has been, by 20 votes to 14, cast out, and Mr. Cloran, of Galway, has been appointed. He was present at the meeting, and promised to take up his duties in a week. He returned thanks, assuring the Council that they would not regret their selection. "He had his heart in the work, and would use all his energies and ability to build up the power station in the interests of the citizens of Limerick (Applause)."

The incident speaks eloquently for itself. We think we need make hardly any further comment. It must not surprise Limerick, however, if when it next wants an engineer, it is left severely alone from this side of the Channel. To specify detailed technical qualifications and to allow the knowledge of Irish history, &c., to become the deciding factor, against the advice of a specially engaged expert, is for us the one merriment-making event of this week, but it is distinctly unfair to the English applicants who spent time and money all in vain, and are unlikely even to get their expenses for attending the examination because Councillors are likely to be surcharged therefor! We hope that Mr. Cloran's knowledge of Irish language and history will stand him in better stead than did that of his predecessor, in his efforts to put the Limerick undertaking on a proper footing. For the comfort of the English candidates one feels tempted to add that there is only one thing that is worse than to lose a Limerick appointment—and that is to gain it.

Condensing Plant Contracts. — THE MIRRLEES WATSON CO., LTD., report the following among recent orders received for steam condensing plant:—

Surface condensing plants for Uxbridge and District Electric Supply Co., Ltd.; Anglo Persian Oil Co., per Siemens Bros., two sets; M. Nairn & Co., Kirkcaldy, per C. A. Parsons & Co.; Usine de Tuilière, Bordeaux, per Thomson-Houston Co., Paris.

Barometric jet condensing plants for Chuwo Seito Kaisha, Formosa, per Okura & Co., London; C. & W. Walker, Donnington; and for Durban Corporation, per Hubert Davies & Co., London (with three sets of injection and hot-water pumps and motors).

Low level jet condensing plants for Edinburgh Corporation, per Brush Electrical Co., three sets; and for Dinnington Main Colliery, per British Thomson-Houston Co.

Cooking Apparatus. — Manufacturers of electrical cooking apparatus are invited to give us the names and addresses of any restaurants where their apparatus is used entirely for cooking purposes, as a favourable opportunity is open on similar lines, provided that efficiency, economy and durability can be assured. Energy is supplied at 1d. per unit.

ELECTRIC POWER IN PORTLAND CEMENT WORKS.

BY W. J. COLES, A.M.I.E.E.

THE manufacture of Portland cement is one of the numerous industries in which the use of electrical power has made considerable progress during the last five or six years. One of the chief reasons for this is the considerable change that the method of manufacture has undergone. Rotary kilns, which up to a few years ago were more or less in an experimental stage and formed the exception, are now almost exclusively employed, and a further cause lies in the fact that increased competition and low prices have rendered it more than ever necessary to use that form of power which gives the best all-round result in economy and quality of product.

Both the horse-power installed per ton of annual output and the energy consumed are now much greater than before. The latter, however, has increased at a greater rate than the former, with the result that the load factor has been materially improved with a corresponding reduction in the fuel cost in the case of a private plant and a lower price per unit where the supply is taken from the public mains. The increase in power installed and energy consumed is due, in the first place, to the above-mentioned employment of rotary kilns. The original fixed kiln, having no moving parts, and using coke instead of finely powdered coal, required no power beyond a small amount consumed in certain cases by elevators or conveyors employed for handling the fuel and raw material. A rotary kiln installation, on the other hand, consists almost entirely of moving machinery, which includes the kiln itself, (fig. 1), the coal mill, the fans for air and coal, the clinker cooler, and elevating and conveying gear. These in the aggregate may require from 60 H.P. to 140 H.P. per kiln, depending upon its size and output. A second reason for the increased demand for power lies in the fact that modern specifications call for a much more finely-ground cement, with the consequence that for any given output per week the grinding machinery has to run considerably longer hours or be increased in capacity. In addition to the finer grinding of the cement clinker that is now necessary, it has become the custom to reduce the raw material before burning to a much greater degree of fineness in order to ensure the cement passing the severe tests usually called for as regards soundness and freedom from expansion. It is generally held by cement manufacturers that, other conditions being equal, the finer the raw materials are ground the less likelihood is there of trouble in complying with the tests for soundness. Translating the above statement into figures, we find that in the case of the raw material, where it was usual about 10 years ago to grind to such a fineness that the residue after sifting on a sieve having 5,776 meshes per sq. in. did not exceed 6 per cent., the residue is not now allowed to exceed about 1 per cent. The British standard specification for Portland cement previous to June, 1907, allowed a residue up to 22 per cent. on a sieve having 32,400 meshes per sq. in., whereas, the limit is now 18 per cent., and it is quite usual for manufacturers of high-class cement to grind to as fine as 14 per cent. residue on the above sieve.

While chemically the action which takes place in the manufacture of cement is somewhat complicated and not fully understood even at the present time, yet the mechanical process is comparatively simple. In the case of the semi-wet process which is the most usual in this country, it consists, as is well known, in forming an intimate mixture of chalk and clay (which in a semi-fluid state is termed slurry) calcining the same in a kiln, either rotary or fixed, and grinding the resulting clinker to the fine powder which is known as Portland cement. In the dry process the raw materials are first dried and then mixed and ground to a fine powder in similar machinery to that employed for the cement clinker, after which they are either pressed into bricks and burnt in fixed kilns or the powder is slightly damped and fed into a rotary kiln. The clinker produced is of the same nature as that produced by the wet process, and is ground into cement in the same manner. It will be seen that a Portland cement

works consists of three main departments, the raw material mill, the kiln plant, and the cement mill, all of which are connected by conveying and elevating plant.

Rotary kilns as at present installed usually consist of wrought-iron cylinders of from 100 to 150 ft. in length, and of from 6 ft. to 10 ft. diameter depending on the output,

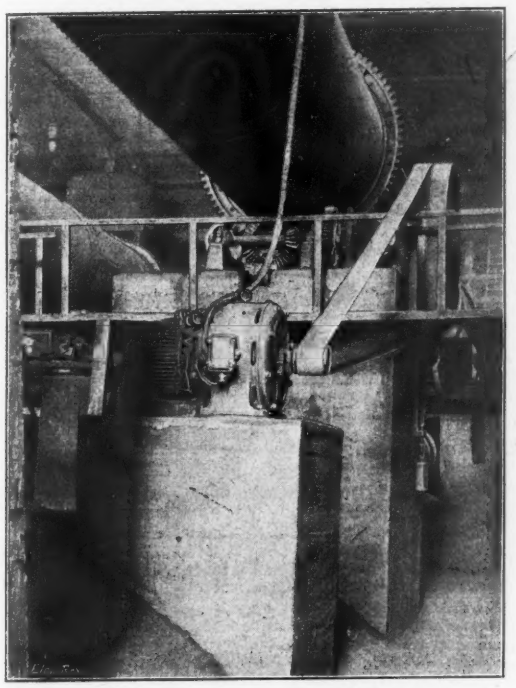


FIG. 1.—ROTARY KILN WITH MOTOR DRIVE.

which varies from 300 to 1,000 tons a week of seven days. Cast-iron has been tried, but has not proved a success except for the end sections. The lining consists of firebrick or concrete composed of clinker and cement. The kilns are mounted on rollers with an inclination of from 1 in 20 to 1 in 30, and are rotated at a speed of from ½ to 1½ R.P.M. Usually, from three to five sets of rollers are used to support the kiln, which is driven by means of a spur or bevel gear ring at about the middle of its length. The size of motor installed to drive the kiln only varies from 15 H.P. to 30 H.P.

In the wet process, the machines generally used for the preparation of the raw material consist of roller crushers for breaking up the chalk or limestone, washmills for further grinding and mixing the chalk and clay, and tube mills or flat millstones for completing the grinding. Ball mills are sometimes substituted for the washmills. In addition, there are mixing basins and pumps for delivering the slurry to the kilns.

Where the dry process is employed, the same kind of machines are used as for grinding the clinker into cement. Ball mills are used for preliminary grinding and tube mills for finishing. Pendulum mills are used either to grind the product in one operation or in conjunction with the tube mills. The coal grinding plant is of the same type as the cement plant.

The power required by the above machines varies considerably, depending upon the size and output and the nature of the material to be ground. Bearing this in mind, the following table may be taken as representative of the usual limits :—

Machine.	H.P.
Raw Material Mill—	
Chalk crushers	7-20
Wash mill	20-50
Wet ball mill	25-50
Wet tube mill	35-65
Slurry mixer	8-30
Slurry pump	6-18
Rotary Kiln Plant—	
Kiln	8-30
Clinker cooler	3-10
Fan	5-18
Coal Mill—	
Drying drum	4-10
Ball mill	15-35
Tube mill	30-60
Pendulum mill	20-35
Cement Mill—	
Ball mill	30-65
Tube mill	50-100
Pendulum mill	30-50

The above table does not, of course, include all the machines installed in a cement works, as no mention is made of the elevating and conveying plant, for which no figures of value can be given in this form. It may be stated that ordinary worm conveyors of from 8 in. to 12 in. diameter, for powdered materials, require from 8 H.P. to 12 H.P. per 100 ft. of run.

Among special types of grinding machines are the Roulette mill, manufactured by Messrs. Amme Giesecke & Konegan, which requires about 30 H.P., Messrs. Hadfield's gyratory crusher, which takes from 25 H.P. to 50 H.P. according to output, and the Freeman mill of Messrs. Aveling & Porter, Ltd. Fig. 2 illustrates the improved form of ball mill manufactured by Messrs. F. S. Smidth & Co., of Copenhagen, and known as the "Kominor" mill. It will be seen that the drive from the motor is transmitted by means of the special form of jockey pulley gear known as the "Lenix."

Turning now to the actual management of the power plant, it should be noted that the usual practice prior to the advent of the rotary kiln and electric driving was either to install one engine to drive the raw material plant and another for the cement mill, or to put down one engine to drive the whole works. The former arrangement gave greater flexibility, and in certain cases better economy in fuel, owing to the practice in many works of running the raw material plant in the daytime only, and the cement

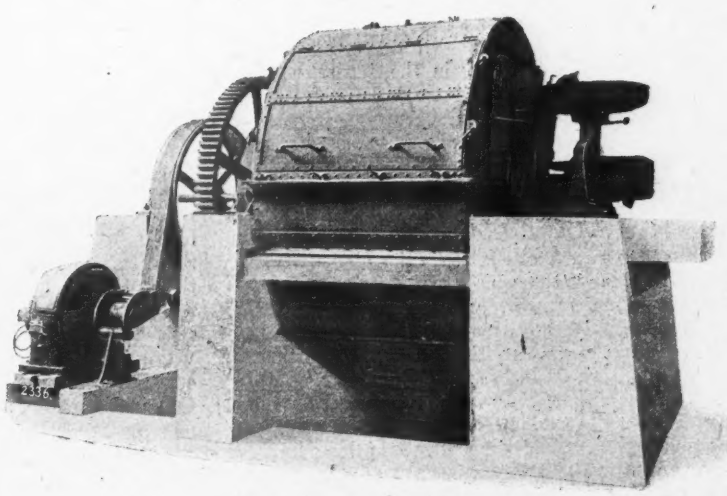


FIG. 2.—IMPROVED BALL MILL WITH ELECTRIC DRIVE.

grinding plant day and night, thus considerably improving the plant load factor. The amount of engine power installed per hundred tons of weekly output has risen from about 70 H.P. to 130 H.P., due to the use of rotary kilns and the finer grinding. These figures are, of course, only approximate, and will vary considerably in particular instances, owing to

the variations in the nature of the raw material and the fineness to which the cement is ground. It should be mentioned that one cause of the increase in the amount of power required is the greater resistance to grinding that clinker produced in rotary kilns exerts, compared with that from the older type of fixed kiln.

The output of a cement works in this country may be anything between 300 tons and 3,000 tons per week, the average lying between 600 and 1,500 tons. The figures given for power would doubtless in some quarters be considered unduly high, but they provide for auxiliaries such as lighting and pumping, and in practice it is always found desirable, if not necessary, to provide a reasonable margin. The writer has in the course of practice met with several instances of comparatively modern plants which have been designed with an insufficient power reserve, and in every case the result has been disastrous. It is particularly necessary where internal combustion engines are installed that a liberal margin above the rated output be provided.

It is, perhaps, not generally appreciated, particularly among electrical engineers, that the conditions under which cement machinery operates are, as regards dirt, dust, and long hours of running, onerous in the extreme, and for these reasons, apart from others, it is essential that the power plant and installation throughout should be of the best and most suitable type. The amount of electric power installed in cement works in this country varies from one or two small motors used for driving, perhaps, the repair shop and some small auxiliaries, to a complete equipment in which every machine is electrically driven. However, to the best of the writer's knowledge there has not been up to the present any works built in this country, which, from the outset, has been entirely electrically driven from its own power plant. The reason for this has apparently been that the owners and their advisers have insufficiently appreciated the possible advantages therefrom. The chief benefits to be derived are as follows :—

1. The engine room can be located in any part of the works independently of the position of the running machinery.

2. The various departments can be located independently of each other, and of the engine room.

3. Variable speed for particular machines can be easily and economically arranged for.

4. Any department can be shut down at will without, as is often the case, running long lengths of idle shafting for considerable periods.

5. In the event of one engine being shut down owing to an accident or repairs, the remaining engine (where two are installed, which is usual) can supply power for whichever department it is most important to keep running at that particular time.

6. The works can be extended in the future with a minimum of expense and trouble, both in the initial stage and later on when additions are required.

Location of Engine Room.—In designing a new works or remodelling an existing one, it is frequently of considerable advantage to be able to locate the engine room away from the centre of the works on account of thus having increased facilities for handling coal and water. In addition to this, it enables one to overcome satisfactorily the difficulties due to dust, and to arrange the grinding plant in a more convenient and compact manner, and so save unnecessary expense in buildings and conveying plant.

Location of Departments.—With the various departments direct driven by means of ropes and belts, it is necessary to have all the machines located within a comparatively short distance of the engine room, in order to avoid excessive loss of power and heavy capital expenditure in long lines of shafting and gearing. Further, it necessitates placing the buildings parallel or at right angles to the engine room, to dispense with angle drives which are objectionable. Where electric motors are used, the location of the various departments relatively to the engine room and to each other is immaterial so far as the driving of them is concerned. This means that it is often possible to arrange them in a much more advantageous manner, having regard to the process, than if direct rope or belt driving is used. Further, when arranging the driving of outlying auxiliary plant such as wharf cranes and elevators, and conveyors for raw material and coal, the use of electric motors in the place of small non-condensing steam engines means a very appreciable saving in fuel and upkeep.

(To be concluded.)

INDIAN NOTES.

[FROM OUR OWN CORRESPONDENT.]

THE Allahabad Exhibition was officially opened on December 1st by the Lieut.-Governor of the United Provinces. In an extremely interesting and practical speech he pointed out the aims and objects of the Exhibition, and laid particular stress on the necessity of the educated youth of India directing his attention to technical work and all its branches, instead of seeking the more easy paths of Government office work. The Exhibition is, for India, a magnificent one, covering an extensive area, and it contains some fine buildings of typically oriental character. The display of arc and incandescent lighting is good, most of the buildings and entrance gates being outlined in light. From an electrical standpoint there is nothing strikingly new or impressive. The main generating station, which can as yet hardly be said to be complete, is equipped with a very fine exhibit of Babcock & Wilcox boilers with chain grate stokers, and two steel chimneys which form a conspicuous landmark. The generating plant is made up of several units all varying in type. A Fielding & Platt gas engine is doing excellent and useful work; and a Belliss & Morcom set is giving the satisfactory results that one usually looks for in this make of engine. It is regrettable that on the opening day the power house was in such an unfinished condition, and it was made plain to visitors that they were not welcome to inspect it.

The greater part of the main cable and distributing work is carried out on the overhead system, on Hamilton poles. Generally speaking, for India, this is satisfactory, except at crossings and junctions, where unsightliness can scarcely be avoided. There are a few large direct-current motors to be seen and heard here and there, but none of special importance. Alternating-current machinery of any kind is noticeably absent. Messrs. Balmer, Lawrie & Co., Octavius Steele & Co., and Oslers, Ltd., have, perhaps the most attractive electrical exhibits of their kind. The first two of these firms make a speciality of motors, dynamos, switchboards and accessories, while the last-named firm in a separate pavilion makes a special display of crystal and metal fittings which form a very attractive feature.

Probably the most interesting part of the Exhibition to Indian engineers, is the pumping section where almost every species of pump, both ancient and modern, is on view. The modern iron adaptation of the old Persian wheel is found side by side with the Humphrey pump; the humble cooly-worked "picottah," of improved and modified pattern, bravely vies with its next-door neighbour, the direct-coupled high-speed paraffin centrifugal, all endeavouring to convince the bewildered P.W.D. engineer of their merits, and of their ability and willingness to quench the thirst of the many millions of acres of land in India still waiting to be irrigated. When it is considered that 40 crores of rupees' worth of capital is invested in water-lifting appliances of a crude kind in India, it is not to be wondered at that the pumping section of the Exhibition is the one to which very great interest is attached by the authorities. There are a few electrically-driven pumps, but none of any special importance. On the banks of the Jumna River there is a special pump house, where some interesting water-lifting trials are about to take place. Three representative types of high-lift centrifugals are fixed there—(1) a Gwynne pump, belt driven by a Marshall compound loco. engine; (2) a Rees Roturbo self-regulating pump, belt driven by a Hornsby engine consuming crude oil; and (3) a Worthington centrifugal, belt driven by a Diesel engine. These three sets are at present supplying water to the Exhibition tanks. Later on, official trials will be made by a committee of specialists.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Re Registration of Colliery Electricians.

I quite agree with the correspondent in your issue of the 6th inst. *re* registration of colliery electricians.

In my opinion there are very few competent colliery electricians who would not welcome some form of registration.

My own experience is this: On applying for a situation at a colliery where accidents are not infrequent, I was informed by the engineer that my technical qualifications were of zero value.

If this is the case, and colliery plants are entrusted to rule-of-thumb men, some of whom don't know the difference between A.C. and D.C. machinery, are we to be surprised at so many accidents, &c., being attributed to the use of electricity?

What I suggest is this: The Home Office should arrange some kind of examination, and make all present-day, as well as intending, colliery electricians satisfy the examiners that they are fully qualified, both practically and theoretically, before allowing them to take up positions where even a slight mistake may result in serious accidents.

Pro Bono Publico.

Network Plans and Diagrams.

In your issue of 13th inst., Mr. Rycroft's article on "Network Plans and Diagrams" describes a very pretty and useful method of recording network details for those supply authorities who can afford the time and expense necessarily incurred in producing them. I have endeavoured to keep my mains records on very similar lines, and, like many of your readers, no doubt, would like to know the best way to deal with alterations to existing entries, which is the chief difficulty met with in all such permanent records. Take an instance, for example: A consumer's premises are pulled down, more or less, for alterations and rebuilt, the old 2-core service is pulled out, and a 3-core laid. Again, in another case a fresh occupier (being a strong opponent) has the service cable, &c., cleared off the premises, and then possibly in a year or two a subsequent occupier becomes a consumer. Then there are street alterations, which means shifting cables, a box, or, may be, a feeder-pillar. Is there a less unsightly method than that of pasting a patch of paper over the part and redrawing?

Wotsle.

Fair Play in Marylebone.

It may interest contractors to know that they who do wiring work in the above borough must work in accordance with the rules of the Inst.E.E., whilst the Council authorities ignore them. This refers to conduit being electrically continuous and earthed. This is a handicap in tendering against the Council, and all we ask is, "Is this fair play?"

The above statement can be proved, and in addition, we might add that the Council, under the guise of "A Satisfied Consumer," gets top price for this inferior work.

pp. **R. N. Cunningham & Co.,**
R. N. CUNNINGHAM, A.I.E.E.

London, W., *January 17th*, 1911.

Electrical Progress in Lancashire.—In an article on this subject appearing in the *Manchester Evening News* for January 12th, the writer says that the past year was one of the most remarkable for electrical developments in the district, since electrical usage came to the front. "No industry in Lancashire has advanced with such rapid strides as that of electrical engineering. It may now be said to have touched every other trade at some point or other, and probabilities suggest something like a phenomenal adoption of electricity for motive power during the next few years."

THE PHYSICAL SOCIETY'S EXHIBITION.

(*Concluded from page* 52.)

MR. LESLIE MILLER.

MR. MILLER'S exhibit consisted of a continuous-current transformer, a patent for which has been applied for. The instrument is essentially a small Tesla coil, made in portable form, and adapted for stepping up or stepping down the street mains D.C. supply. At the Exhibition the voltage at disposal was 100 only, and the main circuit consisted simply of a small horse-shoe electromagnet wound with fine wire, having a light armature of the trembler bell pattern, and breaking the current between platinum points. In shunt to the break there was a 500-volt condenser, with a capacity of three or four microfarads, in series with the primary of a

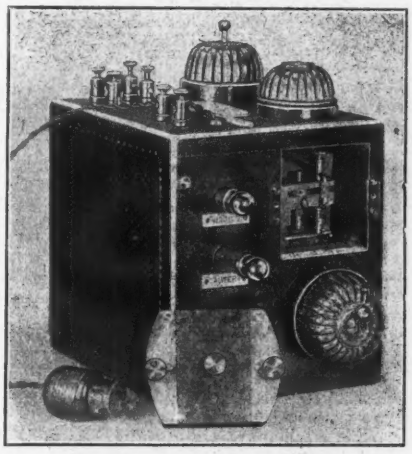
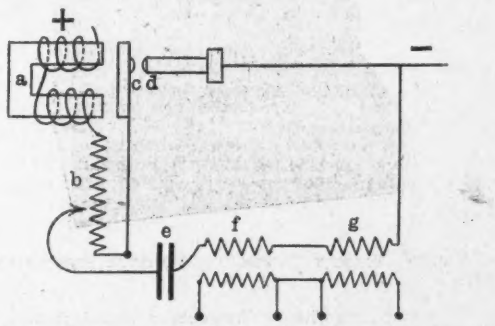


FIG. 22.—MILLER D.C.-A.C. TRANSFORMER.

transformer, or the two primaries of two transformers in series with one another (fig. 23). In the latter case the secondary of one transformer was shown lighting a small 10-volt lamp quite steadily, while that of the other was employed simultaneously for heating a medical cautery burner taking 8-10 amperes. The instrument took about ½ ampere from the mains and was protected by a 1-ampere fuse.

Another instrument was shown in action working a small step-up transformer which sent a very rapid stream of fine sparks resembling a line of fire across an air gap of about an inch, and producing a musical note. When the street supply is 200 volts the same coil in series with a non-inductive resistance sparks across 2 in., and it may be pointed out that the higher the voltage of the mains the more favourable it is to the instrument, as a smaller condenser can be used. The charging voltage of the condensers, however, depends on the voltage set up by the interruption of the circuit, which may consist of any proportions of inductance and ohmic resistance, so that, theoretically, the instrument can be used on quite low voltages.

It is suggested that the instrument would make a very good transmitter for wireless experiments over short distances. It does well for testing motor-car coils, suspected of being broken down. It would also answer for testing insulation. For instance, the wiring of a building cannot be tested with its own current without



a, Electromagnet; *b*, Resistance; *c d*, Interrupter; *e*, Condenser *f*, *g*, Primaries of transformers.

FIG. 23.—CONNECTIONS OF TRANSFORMER.

testing that of the mains at the same time, but as the secondary of the transformer of this instrument can be perfectly insulated from the primary and earth, it could be employed in connection with any of the new detectors of alternating current. In general, the high-frequency alternating current from the secondary can be super-

imposed on the primary continuous current, and used for signalling purposes. Other uses will doubtless follow.

Much experimental work had to be done before the instrument was made a practical success.

INDIA-RUBBER, GUTTA-PERCHA AND TELEGRAPH WORKS CO., LTD.

Besides the Rymer-Jones patent standard condenser and universal shunt, both of which we have described, and the Silvertown portable testing sets, the India-Rubber Co. showed the Bleeck-Love primary cell—a new two-fluid cell, giving a high E.M.F. together

FIG. 24.—BLEECK-LOVE PRIMARY CELL.

with great capacity and constancy. The cell is illustrated here with; the zinc and excitant are enclosed in a porous pot, and the carbon and depolariser in an outer vessel. It is stated that the chemicals are simple, and that the cell can be recharged in a few minutes; two cells will charge a 20-A.H. 4-volt accumulator in 16 hours, or run a 2-volt 4-C.P. lamp for 18 hours. The composition of the fluids used is not stated.

MESSRS. ELLIOTT BROS.

MEASURING instruments of various kinds, for D.C. and A.C., micrometer gauges, &c., were shown by this firm. A noteworthy feature was their new double type of recorder, for combined volt and ampere, vacuum and pressure, and other records; this is made up

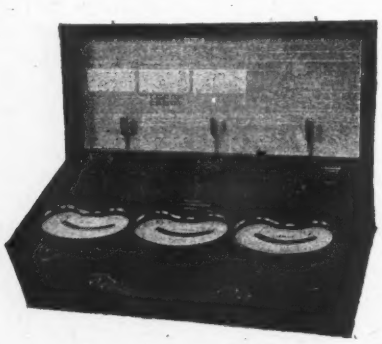


FIG. 25.—ELLIOTT TRIPLE DYNAMOMETER TESTING SET.

in switchboard form with cast-iron case, or portable form in a teak case. These recorders are used, for example, in battery installations, with a centre-zero ammeter recording charge and discharge. We illustrate a new triple A.C. dynamometer testing set, consisting of a voltmeter, ammeter and wattmeter in one case, which, with the aid of portable transformers if necessary, can be supplied for any current and pressure.

The Wimperis accelerometer has also been further developed, a recording type being now made, which should prove very useful for the purpose of investigations in connection with electric trains and tramcars, electric lifts, &c.

THE FOSTER INSTRUMENT CO.

An interesting instrument was shown by this firm, known as the Foster fixed-focus radiation pyrometer; it differs from other radiation pyrometers in that for many purposes it can be used, as its name implies, without focusing upon the hot body. This is effected by the following consideration: The concave mirror C (fig. 26) produces an image of the aperture E F at the point D, where the hot junction of a small thermo-couple is fixed. So long as the whole of the solid angle represented by A G B is filled with radiation from the hot body, the reading of the instrument will be the same as if the hot body were actually at the aperture E F, and therefore accurately in focus. This end is attained if the distance from the apex of the cone G to the hot body does not exceed a fixed multiple of the smallest dimension of the radiating surface, a condition that is readily fulfilled. The thermo-couple is connected to an indicating milliammeter, the scale of which is direct reading

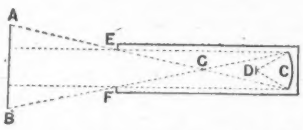


FIG. 26.—DIAGRAM SHOWING PRINCIPLE OF FOSTER FIXED-FOCUS PYROMETER.

in terms of the temperature of the hot body. The cold junction of the thermo-couple is $\frac{3}{16}$-in. away from the hot junction, so that both are equally affected by variations in the temperature of the tube, and the readings are independent of the latter.

In the Foster "base-metal" thermo-couple, alloys of cheap metals are employed, which give a higher E.M.F. than the rare metals, with lower resistance, so that the force available to actuate the indicator is 30 times as great as in the "le Chatelier" pyrometer. These alloys are suitable for temperatures from 150° C. to 1,200° C. The instruments above described are of exceptionally simple and robust construction, as well as of low price, so that they are well adapted for use in industrial processes.

MESSRS. H. TINSLEY & CO.

One of the most remarkable exhibits was that of this firm, including as it did a number of A.C. apparatus developed in conjunction with Dr. C. V. Drysdale, or under his patents. The Drysdale A.C. potentiometer was especially noteworthy; this instrument covers an extraordinary variety of applications, enabling the vector diagrams of all kinds of circuits to be immediately constructed from the readings obtained. In conjunction with this, the Drysdale-Tinsley vibration galvanometer was shown, which has a moving system independent of the galvanometer windings, and is tuned by means of a magnetic shunt. Drysdale's non-inductive shunts and polyphase wattmeter—the latter provided with a remarkably ingenious commutator—Tinsley's universal potentiometer, and Orling's capillary siphon recorder, were other interesting items. We hope, at a future date, to publish particulars of some of these novel and, in some cases, unique devices.

MESSRS. A. C. COSSOR, LTD.—The speed indicator invented by Mr. W. R. Cooper was shown working, as well as Rose's patent high-vacuum oil pump, in which the iron piston is enclosed in a cylinder, and is operated by an external solenoid, which is caused to move up and down. A new X-ray tube was also shown.

MESSRS. R. & J. BECK showed the Beck-Gordon lamp for illuminating microscope stages, and the Holophane lumeter—a surface brightness photometer of small size—as well as a variety of other physical apparatus.

BRITISH RADIO-TELEGRAPH AND TELEPHONE CO., LTD.—A multiple rotary spark-gap for wireless telegraphy, producing musical notes by interrupting the condenser discharge at regular intervals, was exhibited by this company.

MESSRS. GAMBRELL BROS. showed a potentiometer of new design, and other electrical apparatus designed by Mr. J. P. Yorke were shown, as well as Messrs. Gambrell Bros.' "fool-proof" galvanometer and sensitive moving-coil galvanometer.

MESSRS. MORRIS & LISTER, LTD.—A time element circuit-breaker was shown by this firm, depending upon the expansion of two strips of metal carrying the current of the circuit to be protected. The thermal capacity of the strips gives the time element, the release taking place more quickly with heavy than with light overloads.

MESSRS. MUIRHEAD & CO., LTD., showed a simple electromagnetic rectifier, for which an efficiency of 90 per cent. is claimed. The device consists of a rocking bar actuated by solenoids connected to an A.C. transformer, and making contacts in synchronism with the alternating current, in such a way that a unidirectional current is obtained, which can be used to charge accumulators, &c.; both halves of the A.C. wave are utilised.

MESSRS. NEWTON & CO. exhibited the Apps Newton "Instanta" coil, for X-ray work, and the Dessauer break, an improved type of mercury interrupter, depending upon a novel application of the centrifugal principle. They also showed a variety of X-ray tubes and accessories.

THE WESTON ELECTRICAL INSTRUMENT CO. had a large exhibit of their well-known switchboard and portable instruments, D.C. and A.C., in numerous patterns.

MESSRS. WRIGHT & CO. exhibited Prof. E. and W. H. Wilson's spark coil apparatus for high-frequency work, as demonstrated at the British Association last year, and described in our pages.

LEGAL.

UNDERGROUND ELECTRIC RAILWAYS TURBINES.

IN the Divisional Court, on Wednesday, January 11th, before the Lord Chief Justice, Mr. Justice Hamilton and Mr. Justice Avory, a special case, under Sec. 19 of the Arbitration Act of 1889, in the matter of a pending arbitration between the British Westinghouse Electric and Manufacturing Co., Ltd., claimants, and the Underground Electric Railways Co. of London, Ltd., respondents, came on for hearing.

The special case was stated by the RT. HON. ALFRED LYTTELTON, K.C., the Arbitrator appointed under the submission to arbitration.

The case was that by a contract of March 12th, 1902, made between the Metropolitan District Electric Traction Co., Ltd. (whose rights and liabilities were vested in the respondents) and the claimants, it was agreed that the claimants should provide, deliver and erect within the times mentioned and in accordance with the specifications, eight steam turbines and eight turbo-alternators combined, at the price of £250,000, payable in the instalments specified in the contract, the last instalment to be paid when all adjustments had been made, and the machines had been operated in commercial service for 60 days to the reasonable satisfaction of the purchasers. There was a subsequent agreement, by which another specification, dated February 13th, 1903, was substituted for the original specification.

By the contract it was provided that every difference or dispute as to the meaning or effect of the contract and specification should be referred to arbitration, and disputes having arisen the subject was referred to Mr. Lyttelton as arbitrator, who stated this case for the opinion of the Court on points of law as follows:—

During the years 1904, 1905 and 1906 the claiments provided, erected and delivered to the respondents eight steam turbines and eight turbo-alternators. At various dates the respondents paid to the claimants on account of the price of the machines, the sum of £159,431 3s. 2d., and after allowing for sums admitted to be due from the claimants, and certain agreed reductions of the contract price, there still remained a large sum as the unpaid balance of the contract price.

The machines were defective in design and efficiency, and did not comply with the provisions of the contract and specifications. They failed to satisfy the provisions with respect to economy, and their steam consumption was extravagant, and materially exceeded that which the claimants guaranteed. The respondents, nevertheless, accepted the machines and used them for the purpose of their railway and undertaking, reserving always their right to damages in respect of breaches on the part of the claimants, and losses and expenses.

In 1907 the claimants, with the respondents' consent, removed one of the machines from the premises of the respondents, and, by making alterations and improvements, endeavoured to bring it into conformity with the contract and specifications. The respondents, always reserving their rights, acquiesced in these experiments.

After many months of these experiments the claimants failed to bring the machine, even as reconstructed by them, into conformity with the conditions of the contract, and the respondents determined to replace the claimants' machines with others, and they made arrangements to substitute for the claimants' machines, machines of different design and manufacture called "Parsons" machines.

Respondents for a considerable time after the delivery of the machines by the claiments failed to provide or maintain suitable and efficient condensing apparatus and appliances for the machines, and these defects in the condensing apparatus materially increased the loss arising from extra consumption of coal and the extra expense of labour and disposal of ashes. But these defects had been remedied in 1908, and did not apply to the claimants' reconstructed machine.

The claim of the claimants was for the unpaid balance of the price of the machines. The respondents counterclaimed much larger sums as damages for the claimants' breaches of the contract.

The Arbitrator found as a fact that the purchase of the Parsons machines by the respondents was a reasonable and prudent course, and that it mitigated or prevented the loss and damage which would have been recoverable from the claimants, if the respondents had continued to use the claimants' defective machines in the future. He further found that the purchase of the Parsons machines was to the pecuniary advantage of the respondents, and that the superiority of the Parsons machines in efficiency and economy over those supplied by the claimants was so great that even if the claimants had delivered to the respondents machines in all respects complying with the conditions of the contract, it would yet have been to the pecuniary advantage of the respondents at their own cost to have replaced the machines supplied by the Parsons machines, as soon as the latter were to be obtained.

Paragraph 17 of the special case was as follows:—The contention of the claimants in substance was that having regard to the above facts I was entitled to draw the inference that the commercial life of the claimants' machines had expired at the date of the purchase by the respondents of the Parsons machines, and that the said facts were therefore relevant to the question of the amount of damages recoverable on the counterclaim, and that accordingly no further damages of any kind were recoverable from them by the respondents after the date when Parsons machines were procurable by the latter; and further, that the cost of procuring and installing Parsons machines was not recoverable by the respondents from the claimants.

The respondents contended that the cost of the purchase and installation of the Parsons machines was recoverable by them from the claimants, as being the necessary cost and expense incurred by the respondents in mitigating or preventing (as from the respective dates when a Parsons machine was substituted for each of the claimants' machines) the damages which they would otherwise have been entitled to recover from the claimants.

The questions of law for the opinion of the Court were: (1) Whether the contention of the claimants set forth in paragraph 17 is well founded. (2) If not so, whether the respondents are right in their contention that the cost to them of the purchase and installation of the Parsons machines is recoverable by them from the claimants as part of the respondent's damages.

MR. FITZGERALD, K.C., who appeared for the respondents, said the sole question for the Court was the measure of damages.

Their LORDSHIPS intimated that the claimants should open the case.

SIR ALFRED CRIPPS, K.C., for the claimants, read the case stated above, and said at the time of the contract the turbine engine was in an experimental stage, and the respondents, after experimenting with the claimants' machines, found that they were not up to contract requirements. But from the time that the respondents substituted the Parsons machines they had suffered no damage at all, because the substitution of the Parsons machines put them in a better position. They substituted the Parsons machines for the claimants' machines because it was to their financial advantage to do so.

On the case being resumed on Thursday, January 12th, SIR ALFRED CRIPPS continuing his argument for claimants, contended that the actual loss should be the basis of the damage. Any advantage from the purchase of the Parsons machines ought to be taken into consideration.

MR. FITZGERALD pointed out that the first order for the Parsons machines was not given until the matter had been before the arbitrator. The cost of replacing the claimants' machines was no less than £80,000.

The LORD CHIEF JUSTICE intimated that at that time the view of the Court was that the first question to be decided was when would proper contract—not bad contract—engines under ordinary circumstances be scrapped? Having ascertained that, the respondents would be entitled to damages for having had to work these bad engines during the time they did, prior to the natural time for scrapping. The arbitrator had found that the purchase of the Parsons engines was a reasonable and prudent course, and that it mitigated or prevented the loss which would have been recoverable if the respondents had continued to use the defective machines. It looked as though he meant that the amount of damage recoverable would have been larger if the respondents had not replaced the defective machines with the Parsons engines.

MR. JUSTICE HAMILTON pointed out that the arbitrator found it was prudent and proper conduct on the part of the respondents to install the Parsons machines. That did not look as though the defective machines were near the stage when they would be scrapped.

SIR ALFRED CRIPPS, in reply, said he did not contend that it was otherwise than perfectly prudent and right to install the Parsons machines, but the true measure of damages was the loss thrown upon the respondents by reason of their working the faulty machines until the time when they could be prudently and properly scrapped. They could not charge the claimants for the Parsons machines. The respondents could not by their conduct enhance the damages against the claimants, whether they paid £800 or £800,000 for the Parsons machines.

The LORD CHIEF JUSTICE: Were the Parsons machines competing machines at the time of the contract?

SIR ALFRED CRIPPS: Yes.

The LORD CHIEF JUSTICE: And I suppose the Westinghouse people obtained the contract as against other people?

SIR ALFRED CRIPPS: Yes. The Westinghouse machine is of particular construction.

The LORD CHIEF JUSTICE said this was a very difficult case, and the exact point had never arisen before. He could not, in justice to the case, and to give the opinion which was necessary to the arbitrator, simply answer the two points in the affirmative or the negative. This was a contract of great importance. Some part of the machinery was to be supplied by the respondents, and at first this was found not to be suitable to the machines supplied by the claimants. But by 1908, the material date, this had been remedied, and no point turned on this. A very large sum of money was involved, and the contract was to provide engines to supply the electric current for the running of the Underground Railways. The contract was given to the Westinghouse Co., and they endeavoured to deliver machines which would give the necessary power. The machines were delivered, but they did not come up to contract, and in 1907 the claimants with the consent of the respondents, removed one of the engines, and by alterations and improvements tried to make the machine comply with the specifications. Every opportunity was given to the Westinghouse Co., but after experiments the machine again failed. *Primâ facie*, it seemed to him that the questions to be considered as to the measure of damages were (1) what would be the natural life of a properly-constructed machine, and (2) what would be the damages for having to work the defective Westinghouse machines. If the respondents had not put in the Parsons machines the measure of damages would have been much larger. When a man was relying on breach of contract, he must do what was reasonable not to made the damages greater than they would otherwise be. When the railway company said they had done their best to mitigate the amount of damages, the cost of the Parsons machines must be a matter which the arbitrator must take into

consideration. The way in which the case came before them showed that the arbitrator had found that the action of the respondents had reduced the damages which the claimants would otherwise he called upon to pay. There was no ground for the Westinghouse people to say that because the Parsons machines had sprung up they were not bound to pay damages. It would not be right to adopt the contention that because Parsons machines had been so much improved in 1908, 1909 and 1910, the Westinghouse machines had come to the end of their commercial life.

MR. JUSTICE HAMILTON agreed, and said the questions should be answered: (1) The contention is not well founded; (2) in the affirmative.

MR. JUSTICE AVORY concurred,

In reply to MR. FITZGERALD, the LORD CHIEF JUSTICE said there would be no order as to costs, as the matter would go back to the arbitrator.

BREACH OF CONTRACT.

AT the London Sheriffs' Court, on Wednesday last week, before Mr. Under-Sheriff Burchell and a jury, the United Motor Industries, Ltd., of Poland Street, W., brought an action against the Société Electro Industrielle, trading in Paris and in Hercules Place, Holloway, to recover damages for breach of contract. The case had been remitted from the High Court, judgment having been allowed to go by default.

MR. MCCARDIE, plaintiffs' counsel, said that the defendants, who were a French company, in the middle of 1909 started an English factory, and shortly afterwards entered into an agreement with the plaintiff company, appointing them sole agents in this country for a period of three years as from August 1st, 1909. The agreement had reference to the sale of the defendants' products, and there was a strong clause that the whole of the output of their English factory should take place through the plaintiffs. All the goods supplied were to be of the very best material. Within a very short period, however, serious complaints had to be made, for of 2,000 accumulators supplied a very large proportion was bad. Many of the plates were buckled, twisted and expanded, rendering the batteries useless, while a very large quantity were otherwise defective. It cost the plaintiff company £151 for an electrical expert, they had to pay £17 for repairs to certain rejected goods, and £85 in another direction. About the middle of last year the defendants appeared anxious to put an end to the agreement, for the plaintiffs discovered that instead of selling their accumulators through them in accordance with the terms of agreement, they were serving traders at Southsea and elsewhere, and that instead of selling Castle accumulators they were selling a very similar article. The word "Castle" was moulded in the genuine article, but on some of the accumulators sold by the defendants the letters "cas" appeared, while on others the last syllable of the word, namely, "tle" could be traced. The plaintiffs purchased 12 or 14 in different parts of the country, and he (counsel) would ask the jury to assume that the defendants were doing a very large business. They applied to the Master in Chambers for an order calling upon the defendants to produce their books, but they defeated the plaintiffs by saying that the books were in France. That, of course deprived them of proof as to how much the defendants had traded against them, and it would be for the jury to assess the damages.

MR. ADOLPHUS HOFFMANN, manager to the plaintiffs, produced the original agreement. During the 11 months that they did business the defendants supplied witness with accumulators to the value of £1,035. So many of them were defective that witness was constantly receiving complaints from customers. This company was well known for their Castle accumulators, and they had spent thousands of pounds in advertising them. They had supplied nearly everyone of distinction in the motor world in this and other countries. The total amount of business they transacted with the defendants during the 11 months was £2,600. It was very important that no accumulators similar to the Castle should be put upon the market. In June last witness received information that the accumulator, produced, called the Marlboro', was being sold at Southsea. It was in every way similar to the Castle, and witness could trace the letters "l" and "c" on it. In the defendants' catalogue a part of page 11 was taken out of the plaintiffs' catalogue, and in it they said that they were supplying H.M. the King, whereas the plaintiffs had that privilege.

By the UNDER SHERIFF: Their profits for accumulators were about 33⅓ per cent., or about 5s. or 6s. on each. As a consequence of the defendants' conduct the plaintiffs' sales had decreased, and their selling imitations of the Castle would injure their goodwill. He should say that they had suffered to the extent of £1,500 or £2,000.

By the JURY: In January, 1910, the defendants practically suggested the cancellation of the agreement.

The jury awarded the plaintiffs £1,000 damages, and judgment was given accordingly, with costs.

SCARBOROUGH TRAMWAYS CO.

THE summons at the instance of the Scarborough Corporation against the above company for failing to provide a reasonable service of tramcars between November 22nd and December 21st, came before the local bench of magistrates on Wednesday last week, and was gone into at length.

THE DEPUTY TOWN CLERK, conducting the prosecution, said the case was taken under Sec. 92 of the Scarborough Tramways Act, 1902, which provided that the company should at all times give such a service of cars as was reasonably required, and be liable to a penalty not exceeding £5 for every day they failed to comply with the provision. The company was formed, and the tramways laid down and opened in the summer of 1904. Since then there had been in some part or other a continuous service until October 29th last. He admitted that the members of this company were gentlemen who had served the town in various ways, and spent a good deal of time in the welfare of the borough, but the Corporation were acting on a matter of principle, and he urged that the financial position of the company was not a circumstance of the case within the meaning of Sec. 92, and therefore ought not to enter into the consideration of the Bench.

The MAGISTRATE'S CLERK: You don't suggest that the financial position might not be taken as a mitigation of penalty?

The DEPUTY TOWN CLERK proceeded to detail the negotiations that went on, culminating in the decision of the Board of Trade, following a public inquiry, that there should be a limited service, which was specified, during the winter months.

MR. TASKER HART, solicitor, Scarborough, said he was instructed by Messrs. Clarkson & Co., the solicitors to the company, and also the solicitors to the Edmundson's Electricity Corporation in London, to appear on the company's behalf. He said that the company was promoted by gentlemen of public spirit in the town, who did not look at the matter from the point of view of their own pockets, but entirely in the interests of the town generally. The undertaking had proved unremunerative, and had been carried on at a loss year by year. It had been stated there was a loss in the year 1909, of £2,000. The company was without any funds. Edmundson's Electricity Corporation were the means originally of promoting the company, and they were mortgagees of the whole undertaking to the extent of £25,000. It appeared that the whole of the shareholders' money was absolutely lost unless something turned up in future, whereby the financial position of the company would be improved. Since 1909 the working had been carried out at the cost of Edmundson's Electricity Corporation. During the summer months the tramways paid a very slight rate of interest, but during the other months of the year, there was a loss week by week. It culminated in October in the company finding themselves entirely unable to carry on the undertaking. They applied to the Board of Trade for a suspension of the service of tramcars during the whole of the winter months, but that application was refused. Then the inquiry took place and the order referred to was made. He urged that Sec. 92 was never intended to apply to a company which, for financial reasons, was absolutely incapable of carrying out the undertaking. It was only intended to apply to contumacious offenders. He submitted the proper remedy for the Corporation was to take advantage of Sec. 42 of the Act, which provided that if after inquiry by the Board of Trade referee, the promoters were found insolvent, the powers of the promoters should, at the expiration of six months, be at an end unless purchased by the local authority.

The MAGISTRATE'S CLERK: That is the extreme penalty, and sentences the Tramways Co. to death.

MR. HART, in any event, submitted the case should be adjourned for six months, when the company might be in a position to do something. If the Bench inflicted a penalty, there was nothing upon which they could levy, because everything was covered by mortgage. They could not touch tolls, because that very Court had already made an order that a Receiver be appointed to receive the tolls in respect of a sum of £515 interest due to August 1st, 1910. Interest had been running since then, and if there were no tolls for another three or four months there would be nearly nine months' interest more in arrear. The Court would have no power to recover penalties, and if they had not that power it would be useless to make the order, because Parliament never contemplated that a body of directors should have to pay these fines themselves.

In reply to the Magistrate's Clerk, MR. HART said that he had no offer of any kind to make as to a restarting of the tramcar service.

The Magistrates were 35 minutes in considering their decision, which was that the Tramways Co. be fined 10s. per day for the 28 days covering the period of the summons, and pay the costs (9s.).

THE MARCONI PATENT CASE.

ON Wednesday last week Mr. Justice Parker, in the Chancery Division, resumed the hearing of the action of Marconi and Others *v.* The British Radio-Telegraph and Telephone Co., Ltd.

Continuing his opening of the defendants' case, Mr. T. TERRELL, K.C., said that when the Court rose he was dealing with the question of what was done before Marconi; his contention was that whether or not there had been anticipation, there was no subject matter in Marconi. Further, if it could not be said that Marconi had been anticipated, taking Braun, and having regard to the state of public knowledge at the date of Braun, there was no room for subject matter in the Marconi patent. He would call a very large body of evidence to show what Braun really did and how it affected Marconi. Braun, first of all, started with the idea that there were various waves. There were the short waves of Hertz which had been hitherto used for wireless telegraphy, there were longer waves which, though considerably longer, might still be called short waves, and then he said there were the dynamo waves, which were very long indeed. Braun had pointed out that they should use a lower frequency, and had shown how to do it. Now what Braun did was to make provision for an alternating wave length by increasing the capacity, and so increasing the energy. He wanted a long train of vibrations. The capacity must

be increased, but not the self-induction, and though they must get great capacity in order that they might issue great energy at the transmitting end, they must not increase the self-induction there. The Marconi wire of 1896, he submitted, was a well-known transmitting wire. It was a wire to air and earth. Any electrical engineer of that time would so understand it. Braun meant that he was going to increase his wave length, but was not going to increase it by self-induction, but by increase of capacity. The evidence he would call would show that what Marconi had done was done, and well done, by Braun. The well-known vertical sending wire mentioned in Braun's specification was always a wire with an aerial to earth. That was the Marconi aerial wire, and the only one in practical use. In conclusion, he submitted that upon the evidence he would call, anyone at the date of Braun was entitled to tune the first circuit to the second, and that all the matters dealt with by Marconi's 1900 specification had been anticipated by Braun.

The first witness called for the defence was MR. W. D. DUDDELL, F.R.S., who, in answer to questions by MR. COLEFAX, said that he had studied wireless telegraphy since 1897, but prior to 1900 he had done nothing practical. Dealing with the Marconi 1900 specification he said that prior to that date auto-transformers were known, but they usually had iron cores. In Tesla's transformer great care was taken to get insulation between the primary and secondary circuits, and the transformer was placed in an oil bath. At the date of the plaintiffs' patent, an auto-transformer might have had an iron core or it might not. At that date auto-transformers were not recognised as being transformers of a kind suitable for transmitting a very rapidly alternating current. To the best of his knowledge that was the opinion of electrical engineers at that date.

His LORDSHIP asked whether they were, in fact, suitable.

WITNESS said they were not, but the auto-transformer without the iron core was suitable for all purposes.

At that date, in so far as auto-transformers were known, were they known with an iron core or without?—With an iron core.

Was much known at that date about an auto-transformer without an iron core?—Very little. Witness added that the only apparatus prior to 1900 was the Oudin resonator. The auto-transformer Mr. Swinburne referred to as having sold before 1900 he understood to be for electric light. He presumed that it would be an auto-transformer with an iron core. Prior to 1900 an auto-transformer was always spoken of as a separate instrument from a transformer. The four principal exponents of auto-transformers were Tesla, Jackson, Thompson and Fleming. They did not use the word transformer for a plain shunt.

All these auto-transformers as shown acted partly by shunt?—Not all of them. The major part of the action was due to mutual induction. It would not be a satisfactory transmitter if they had an iron core in the primary, because the losses in the iron were so considerable.

If there was no mutual induction, what would in fact be produced in the aerial of the transmitter?—Nothing in any of these.

MR. ASTBURY: Do you say that a two-coil transformer acts only by way of mutual induction?—Yes, only by mutual induction.

At the date of Marconi's 1900 specification was any transformer known as being suitable for transforming all rapidly alternating electric currents which did not work by mutual induction?—No. Tesla was working on that basis. The Oudin resonator worked in part by mutual induction and in part by what had been called shunt action.

Is there anything in Marconi to show that he puts the primary and secondary in tune in all cases?—There is not.

MR. ASTBURY objected that not a word of this had been put to the plaintiffs' witnesses.

MR. COLEFAX: If you want to pick up a distant station or one out of several, what you have to do is to vary the periodicity of the wave you are sending out from your transformer?—Yes.

To alter the periodicity is to alter the induction, the capacity, or both?—Yes.

MR. JUSTICE PARKER asked what was the point of the questions. Inefficiency had not been pleaded.

MR. TERRELL said that what they wanted to show was whether the instrument described by Marconi had not the same effect as that of Braun, and was tuned once for all.

In answer to further questions, WITNESS said that no doubt, before Marconi, the picking up of one station after another by wireless messages was an acknowledged desideratum. To do that with a closed oscillating current and an open aerial, it was necessary to tune the primary and secondary circuits, and you had to get both your currents of the same frequency before you could tune. Tesla's transformer was perfectly well known before 1900, and had been frequently used in laboratories.

MR. ASTBURY again protested that this was all new matter.

MR. TERRELL said they did not know of Tesla's transformers before.

His LORDSHIP said he never looked with great favour upon evidence acquired during a case of this kind.

MR. TERRELL said they would have pleaded it as an anticipation had they known it.

MR. COLEFAX asked whether, to send a message by a different tune when they altered the frequency, they altered the aerial?—WITNESS said that as a rule they did not.

MR. JUSTICE PARKER again pointed out that that was not relevant to the issue before him unless the defendants pleaded inefficiency.

MR. TERRELL said they did not plead inefficiency, though he did say that if their view of Marconi was the true view then there was inefficiency.

In answer to further questions by MR. COLEFAX, WITNESS expressed the opinion that read with the knowledge of electricians at that date, Braun's fig. 4 gave the transmitter which was the subject of the first claim. There was nothing about tuning the Marconi aerial. In 1900 they could not send wireless messages so so far as they did now.

MR. ASTBURY remarked that they got across the Atlantic in 1901.

WITNESS said that was so. There were the famous S's, but he believed that a much larger amount of energy had to be used in those days.

MR. ASTBURY, said as it happened, it was with a less amount of energy than was used now.

Cross-examined by MR. ASTBURY, WITNESS said that he began his practical work on wireless in 1904, and he had written and published a considerable amount of information about his work. From 1904 to the present time he had given wireless telegraphy his close attention.

And yet until the commencement of this action you had never heard of Braun's specification?—WITNESS said he had heard of it, but had never seen it.

Continuing, he said one could get a transmitter with good results with either a one-coil transformer or a two-coil transformer.

On the resumption of the hearing on January 12th, MR. ASTBURY said, with reference to an experiment made by the witness (Mr. Duddell) before the adjournment for the Christmas vacation, that Mr. Swinburne seemed to have been misled, and consequently certain of the calculations that he had given he now found to be wrong.

WITNESS said that he thought Mr. Swinburne had not comprehended the real object of the experiment.

Further cross-examined, MR. DUDDELL said that he was not aware that in literature prior to 1900 a single one-to-one coil was called a transformer. He denied that Prof. Bedell, in 1896, called a single-coil transformer a transformer *simpliciter*. He called it a single-coil transformer first, and then a transformer, for the sake of brevity. Witness admitted that, whatever it was called, it was none the less a single-coil transformer.

MR. TERRELL asked whether the particular transformer referred to had an iron core or not.

MR. ASTBURY said it had.

WITNESS, continuing, said that Steinmetz prior to 1900 had mentioned a transmitter, as also had Mr. Swinburne. In a paper he referred to a contrivance as a "transformer pure and simple for electric arc lamp purposes." Mr. Swinburne had probably forgotten that paper when he gave his evidence. In 1904 Arnold showed a picture which was the same as Steinmetz had described in 1897, and that he called a "presentment of a universal transformer." Bash had an arrangement as a receiver which he called a "detransformer coil," and he also described an apparatus as a case of direct coupling which could be considered as a special case of inductive coupling. Zenneck, who was one of the best writers on the subject, had stated that with regard to amplitude and phase the single-coil arrangement was indistinguishable from the double-coil.

His LORDSHIP asked whether it was as well known in 1900 as it was in 1904 that this had the same effect at a distance?—Witness thought not.

MR. ASTBURY.—It was perfectly well known prior to 1900 what were the two effects of a single and a double inductor coil *quâ* amplitude and phase?—Yes, I think it was.

Yet the effect of using either one or the other in wireless instruments had never been suggested and of course was not known?—No.

The effect of a coil between two circuits *quâ* magnitude, magnetic lines, phase of current and other electrical effects was perfectly well known before 1900?—Yes.

Going to Tesla, Counsel asked whether it was not a matter of absolute indifference to Tesla, so long as he got his energy into his secondary circuit, what time it took to pass from the one circuit to the other?—WITNESS said Tesla simply wanted to get the energy into his secondary circuit. Practically it was of no advantage to him to get the energy of his discharge put in at any particular rate. The whole object was to get an even rate of slowness. In Tesla there was some sort of tuning, but it was called adjustment. Tesla and his followers had adjustment for the purpose of getting resonance.

They wanted the resonance in order to get the same perfect pressure in the secondary?—WITNESS said that was one of the reasons, but not the only one. He did not think Tesla had any idea of coupling. Witness thought he wanted to get the highest pressure in the secondary, and did it by this adjustment.

He had no conceivable information of any relationship between resonance and wireless telegraphy?—I dont think he had; I think he had a vague suspicion, like a great many people at the time, that wireless telegraphy was coming.

And that it was coming by electrostatic action through the earth?—Yes.

That shows how very unwise it is, in the light of subsequent knowledge, to read other things into other people's inventions?—WITNESS said he had been thinking so all along.

Asked whether he agreed that there was nothing in Tesla's specification papers or otherwise of any sort or kind that related to any problem of wireless telegraphy, WITNESS said it was not quite that. Tesla knew of certain circuits, but he had no idea that they could be so used. Witness did not think that anyone could take his documents and make a wireless instrument from them. Lodge had done a great deal of work in connection with wireless telegraphy, and if any one understood Tesla and Hertz, it was Lodge. Whatever Lodge did, however, it was quite a different attempt to solve the problem than that found in Marconi's specification of 1900.

Is it not a fact that as a scientific man Sir Oliver Lodge is

1897 knew all the scientific facts that have been proved in this case with the exception of Braun's specification?—Witness would not go so far as that, but admitted that it was all common knowledge. Except so far as tuning, they did not teach anybody anything about the Hertz wave telegraphy, nor to make an apparatus of commercial value that could be worked by the Hertz waves, or anything that would lead to the solution arrived at by Marconi in 1900.

Yet tuning was perfectly well known prior to this date?—Yes.

Marconi knew it in 1896?—Yes.

No information was given as to tuning a closed oscillatory circuit with an open aerial circuit?—No.

Nor the advisability of doing so?—No.

Nor the mode of doing it?—No.

In fact, there was no reference to it at all?—No.

The problem Marconi had before him in 1900 was not to forecast Prof. Silvanus Thompson's patent or to deal with it at all?—Witness said that was so.

Prior to 1899, is there any document that is relied upon as an anticipation which in any way suggests or discloses the production of any particular class of wave by means of circuits and tuning?—Witness thought that Sir Oliver Lodge did it in 1897. He did not think, however, that there was any document prior to the date of Braun which in any way disclosed the production of particular wave lengths by one or two circuits in one instrument, nor did he think that there was any document prior to 1899 which in any way disclosed or instanced the effect upon either the amplitude or length of wave train from the antenna of a closed circuit acting with it.

Up to this date, was it not the universal belief, especially amongst those who had a knowledge of Tesla's machine, that the frequency of the capacity circuit was forced into the open or working circuit?—Witness objected to the word "forced," as it suggested light coupling. Except for that the belief might have been as counsel suggested. It was one idea.

And amongst a large number of leading people?—It may be so.

Continuing, Witness said that there was nothing in Braun to show that he did not intend to impose his high capacity frequency upon his aerial. Asked whether there was anything in the Braun specification to show that he was proposing to tap any capacity with a series of circuits for the purpose of obtaining a train of waves, Witness said he thought it was suggested. Braun wished the energy to be transmitted by a more even increase. There was, however, no hint in Braun in words that you would get the same sustained train of waves of any particular amplitude by reason of anything he showed. There was no reference in words to any necessity or desirability of tuning any part of the instrument. There was no means shown or described in the letterpress by which one could alter the tune of any part of the instrument.

You admit that the aerial referred to meant the aerial that Marconi and other people were using?—Yes, I think the well-known vertical aerial means the Marconi wire. It was a wire used with high frequencies which he wished to avoid. There were discrepancies in the document, but it was not nonsense.

In answer to further questions, Witness admitted that it would be very difficult to say what he would have done if he had only known Braun and did not know anything about Marconi and what had followed since. There was nothing at all in Braun about coupling. To have put Braun into operation, even if he had used a Tesla transformer, there would have had to be a medium coupling.

On January 13th, in re-examination, Mr. Duddell had his attention called to the transformers of Swinburne and Zenneck. Zenneck, in his exposition, witness said, used a development of Braun. Pearce had said that, with regard to transformers, there were two important general types—the inductively coupled and the direct coupled. Pearce also referred to an auto-transformer which was diagrammatically similar to the Nonsuch, except that it was a "step-up" and not a "step-down" transformer. In Marconi's 1900 patent there was no auto-transformer. There was no "step-down" transformer—it was all "step-up." There was nothing in Braun's specification that he (Witness) could find about tuning. Braun first of all wished to use the longer wave and make use of electrical oscillations which had only a small frequency instead of the higher frequency hitherto adopted. An important advantage in using slower vibrations was their potential and amplitude, and the energy was more easily increased. When the Hertzian waves were used there was a certain length of spark which must not be exceeded, because with a high potential there would be too much "damping." The danger was that in increasing the spark-gap one got a wave length which, if it went any further, would make matters worse.

Braun was aiming at a high potential so as to get great distance?—Yes.

Witness said that in Marconi there was no direct mention of coupling. So far as the purity of the waves was concerned, the lighter the coupling the better. If Tesla was put into Braun there would have to be a long aerial.

And not one word of this is mentioned in Marconi?—No.

Mr. Astbury protested that nothing had been said about this before.

Mr. Terrell admitted that it was new, but thought at the beginning of the case that by putting tuning into Braun one would have got complete anticipation.

Mr. Astbury asked the witness if it was not a fact that in 1899 Marconi was using aerials from 100 to 1,000 ft. long?—Witness said that was so.

Do you know they were put up by kites?—Yes.

And is it not a fact that there was public user of the well-known vertical aerial at the date of Braun's specification, the length varying from 100 to 1,000 ft.?—Witness said that aerials of several hundred ft. were used.

Do you find any suggestion whatever in Braun of the length of aerial you should choose?—No.

Mr. Terrell: Is there anything about it in Marconi?—Mr. Astbury: Yes; full details.

Prof. E. W. Marchant, Sc.D., was the next witness called for the defence. Examined by Mr. Colefax, he said that he had given his attention to the problems involved in wireless telegraphy, and he himself had carried out experiments in electrical oscillations. He had never understood a transformer to mean anything but an instrument having two independent coils. He had never heard an inductance called a transformer before this case, and if an instrument like an auto-transformer was employed it was mentioned with a qualifying prefix or some separate description such as economy coil. That was the meaning that the word transformer would have had to him in 1900. The use of the word transformer *simpliciter* would not have conveyed to his mind an auto-transformer. The term, "transformer of a kind suitable for transmitting rapidly alternating currents" in Marconi's 1900 patent, he should have understood as meaning a two-coil transformer. Auto-transformers were known at that date. The vertical aerial in Braun's specification of 1898 was equivalent to the Tesla coil with a vertical sending wire attached, and it was perfectly well known at the time that if they wished to get the best results—the highest potential they had to adjust the two circuits by varying either the capacity or the self-induction, in other words, by tuning.

Witness, continuing, said that if the document had been given him in 1900, that is what he would have done. Braun, in his opinion, had in his mind the adjustment of the circuits so as to get the best result. There was nothing inconsistent with that and tuning. To have got the best results, Witness would have adjusted them so that they were in tune. That would have got the highest potential on the aerial wire, and that was what Braun was trying to do.

In cross-examination, Witness said that he had been in Liverpool since 1901. So far as commercial transactions were concerned, he had had no practical connection with wireless. He had experimented with the Hertz arrangement and the Marconi aerial at Blythswood. He always understood that the object of Braun's specification was to get the highest potential. He admitted that Marconi clearly set out his object to be the increase of efficiency, to enable tuning to take place, and selectivity. He agreed that Marconi obtained those objects by separating the primary circuit from the radiating circuit, and so using a transformer. In addition to the transformer, Marconi had a condenser in series with the primary. Marconi had given information which Braun's specification might not do.

Prof. C. V. Boys, who was next called, said that Tesla surprised the whole world with his small laboratory-made transformer. He could not give figures as to the various couplings, as he had not done them. Asked, reading Braun's specification as a whole, what it would have told him, witness said it showed a system of a condenser consisting of ordinary laboratory Leyden jars, two of them in cascade connected through a self-induction by a spark-gap. There was a closed oscillating circuit inductively coupled with that by means of a two-coil transformer with an aerial at one end which went up in the air and the other end going to earth or somewhere else. There was, therefore, mutual induction between the primary and secondary, the oscillations took place in a closed oscillatory circuit with some of the energy taken off in the open aerial circuit. He had no doubt that that meant the wire that Marconi had made so much use of. He did not think, from reading the documents, that he should have thought about coupling. He had a general knowledge of adjusting the Tesla coil in 1900. He had attended Tesla lectures, and was amongst others electrified by what he showed. The adjustment of the Tesla instrument could only be made useful when it was in communication with that on which it was going to operate. Having read and studied the documents of Braun, he found nothing inconsistent with what had been said about putting it into practice in 1900. There was nothing inconsistent with tuning it.

Would it preclude you from getting any result in the same way Marconi gets it, as described in his specification?—That would be an extremely likely result.

Witness was under cross-examination when the Court rose, and the hearing was adjourned until the 17th inst.

London Electric Supply Corporation, Ltd., *v.* Westminster Electric Supply Corporation, Ltd.

On the motion in this action coming again before Mr. Justice Joyce in the Chancery Division, on Friday last, Mr. Gore Browne, K.C., for the plaintiffs, reminded his Lordship that the object was to restrain the defendant corporation from influencing the plaintiffs' customers. Counsel for the defendants said he was ready to consent to the motion standing over for 14 days, and would give an undertaking in the terms of the notice of motion over that period without prejudice, if the plaintiffs would give an undertaking in damages. To this Mr. Gore Browne agreed, and the motion accordingly stood over until Friday, January 27th.

The Stud Tramways Libel Action.

The Court of Appeal, composed of Lords Justices Vaughan-Williams, Farwell and Kennedy, had before them last week an application by Sir John Williams Benn, the defendant in the action of Griffiths and Another *v.* Benn, for leave to expedite an appeal from a judgment of Mr. Justice Ridley on the finding of a special jury awarding £12,000 damages for libel.

SIR EDWARD CLARKE, K.C., who made the application, said that the appeal had been entered, but since judgment had been signed and execution issued. The execution had, however, not satisfied the judgment, and there was indication that proceedings would be taken that would seriously affect the defendant's position as a member of a public body and his opportunity of rendering public service.

For the plaintiffs, MR. F. E. SMITH, K.C., stated that he did not think there was any desire to proceed against the defendant in bankruptcy pending the appeal, but he must oppose the appeal being expedited.

Their LORDSHIPS were of opinion that the defendant was not in a position to ask that the appeal should be taken out of its usual course, and accordingly dismissed the application.

ELECTRICAL PROSECUTIONS IN LANARKSHIRE.

IN mining and electrical circles in Lanarkshire considerable interest is being taken in two prosecutions for breach of the special electrical rules as applicable to mines, which came before Sheriff Hay Shennan in the Hamilton Sheriff Court on Tuesday of this week. The first complaint was that in which James Salmond, general manager, Woodside Villa, High Patrick Street, Hamilton, was charged with having, on October 20th, in Millburn Pitt, Dalserf, belonging to Messrs. Archibald Russell, Ltd., coalmasters, failed to have "a competent person" in charge of the electrical apparatus. Respondent denied the charge, and was defended by Mr. Jas. Andrew, of Messrs. Mitchells, Johnston & Co., solicitors, Glasgow. A diet for proof was fixed for Monday, February 20th.

The second case was that in which Robert McKay, manager, Cornsilloch Colliery, Dalserf—which colliery is also owned by Messrs. Archibald Russell, Ltd.—was charged with several breaches of the special electrical rules. The complaint set forth that the frame of an electrical motor in the drumgray seam of Millburn Colliery was not sufficiently earthed; that the distribution box of the motor was not earthed; that the terminal on the starting switch of the motor was unprotected by any insulating cover; that the electric lighting wire in the drumgray seam of Millburn Pit was unprotected by a suitable cover, and that it was neither mechanically and electrically efficient nor suitably soldered; and that in the haulage road in the Virtuewell seam of Millburn Pit the electrical cables were suspended on iron nails instead of being suspended by leather or other flexible material.

Objections to the relevancy of the complaint were taken by Mr. James Andrew, solicitor, Glasgow, but these were repelled by Sheriff Shennan, who fixed Monday, February 20th, as a diet for proof. It is understood that both the Crown and the respondents will be represented at the trial by counsel.

MINE EMPLOYE PROSECUTED.

A CASE of much interest was heard at the Manchester County Police Court on Tuesday (17th inst.), when Isaac Pollitt, shot lighter, of Manchester Road, Irlams-o'-th'-Height, was summoned at the instance of Joseph Kay for not himself coupling up the cable to the charge whilst engaged in shot-firing, and using electricity contrary to new rule 71A of the Special Rules in force at the mine.

MR. BUCKLEY said this was a prosecution by Messrs. Andrew Knowles & Sons, colliery proprietors, against a man who was in their employ as a shot lighter in the Agecroft No. 3 Pit, for a breach of the special rules in force under the Coal Mines Regulation Act, 1887. He handed in a copy of the certified rule signed by the Factory Inspector. Under the Coal Mines Regulation Act, 1887, he said there were provisions that special rules could be made in regard to the use of explosives in mines in connection with electricity. Pursuant to the Act the new rules came into force in 1902, and they provided that the authorised shot lighter shall fire all shots, and if electricity is used that he himself shall couple up the cable to the charge, and whilst doing so he shall have the battery with him, and he shall also couple the cable to the battery. The charge against the defendant was that he did not himself couple up the cable to the charge. The way in which these shots were fired was this: A hole was drilled in the coal face, the detonator was put in, and then the cable was attached to the charge by two wires. This cable should be at least 20 yards long. In this case it was 25 yards long. At the very last the cable was inserted into the battery and the shot fired. The shot firer had, however, to see that all men in the vicinity had been moved from the area so that there should be the least possible risk of injury. The shot lighter was the only man left in the neighbourhood, and he should be at least 20 yards away when he fires the shot. Pollitt was appointed shot firer about six years ago, and consequently was a man of considerable experience. Apparently he asked a collier named Wm. Benyon to fasten the cable to the charge. As a matter of fact, when Benyon did fasten the cable to the charge it must also have been attached to the battery, and the consequence was that when he did attach the cable to the charge the shot went off and Benyon received certain injuries, but they were not really of a serious nature. If defendant had carried out the rules, this injury could not possibly have occurred, and nobody would have been affected. The matter was of extreme importance, in view of the serious disasters that might happen in collieries. He pointed out that in 1909 the Home Secretary issued a new order that when the charge was fired by an electrical apparatus the shot firer should use a cable not less than 20 yards in length; he should himself couple the cable to the charge, and he should do so before coupling the cable to the firing apparatus; whilst he should also personally couple the cable to the firing apparatus. Before doing so, he had to see that all persons in the vicinity should have been removed. These were new provisions made within the last 12 months to prevent any injury. This man Pollitt must have known the seriousness of what he was doing, because he had had six years' experience, and he must have known the serious nature of the injuries that might result. At the same time, he was instructed to say that Pollitt was a man of the highest character. There had been no complaint against him before, and this was the first offence that had been charged against him. He was asked by the firm to state that to the Bench, and to ask them to take it into account in inflicting the penalty. The offence itself was a very serious one, but against it the man had an exemplary character. He understood the defendant was going to plead guilty, so there was no need to put the witnesses into the box.

The STIPENDIARY: Do you plead guilty to breaking this rule?

DEFENDANT: Yes, Sir, I plead guilty. I cannot say anything. I have worked there 40 years, and this is the first mishap I have had.

The STIPENDIARY: Why did you do it?

MR. BUCKLEY; I think, Sir, the reason why he did it was that it was 2 o'clock—knocking-off time—and the Eight Hours Act was in force. This is the consequence of it—anxious to save time. Isn't that it?

DEFENDANT: Yes.

The STIPENDIARY said if it was not for the excellent character given the defendant by Mr. Buckley on behalf of the company they would have imposed a very serious penalty, because it was causing a very great risk. In the circumstances they did not think they would be minimising the risk if they imposed a penalty of 20s. and costs.

MR. BUCKLEY asked for a summons to be issued against the man Benyon, who committed an offence against 155*d* New Rules 23, which was that no unauthorised person should meddle with any machinery or electrical apparatus. He did not ask for that to-day, because he had intended putting Benyon in the box as a witness.

A summons was issued.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

A New Portable Tachometer.

An extremely compact and workmanlike series of portable tachometers has recently been put on the market by MESSRS. EVERETT, EDGCUMBE & CO., of Collindale Works, Hendon. Fig. 1 shows one of these instruments, which, in a leather case, which measures only 7 in. × 3½ in. × 3½ in., weighs under 2 lb. complete. They can be constructed to cover a very wide range; measurements can, in fact, be made from 60 R.P.M. up to as high as 12,000 R.P.M. These tachometers can be supplied with either one, three or four ranges and the method of changing from one to the other is extremely

FIG. 1.—PORTABLE TACHOMETER.

simple. As will be seen from the figure, there is a small sliding knob on the barrel of the instrument, and it is merely necessary to move this along to correspond with the range required. This adjustment can readily be effected even while the tachometer is in actual use.

The complete set of accessories contained in the portable leather case comprises, amongst other items, a steel driving point for medium speeds, a rubber driving point for high speeds, a rubber-lined cone for extremely small spindles, an extension piece for use with any of the above fittings in those cases where the end of the shaft is difficult of access, and finally, a steel pulley with grooved rim for use with a cord belt when the end of the spindle is not available. This wheel can also be used to measure the linear velocity of belts, for example, by allowing it to run on the surface, the speed of which is to be measured.

These hand tachometers are made in various sizes, dials of 2½ in., 3 in. and 3½ in. being standards. The instruments, which are

perfectly dead beat, can also be adapted for stationary use, being provided with a light support, carried on a base suitable for fixing to the machine to be tested.

Three-pin Wall Plug.

We illustrate herewith a new three-pin wall plug, which the BERRY CONSTRUCTION CO., of Charing Cross House, W.C., are introducing for their single and extension cookers.

Two pins of the plug are for the electrical circuit, ; the third is connected permanently to the flexible metallic armouring of the cooker cable, and makes contact with the flange of the socket

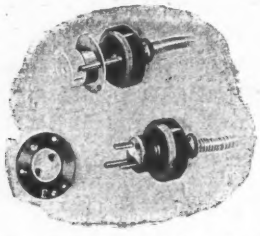


FIG. 2.—THREE-PIN WALL PLUG.

before the electrical circuit is completed. An earth terminal is provided on the socket flange, so that the insertion of the plug earths the cooker case.

A similar socket, but without the earth terminal, is used on the company's Duplex cooker case, so that a single or extension cooker can be connected up without additional wiring. The earth terminal is not necessary in that case, as the flange of the socket is in metallic contact with the Duplex cooker casing and earthed through its own cable armouring.

New G.E. Co. Switchgear.

Several new patterns of switches for low and medium pressures have recently been brought out by the GENERAL ELECTRIC CO., LTD., of 67, Queen Victoria Street, E.C. The "Peel" tandem

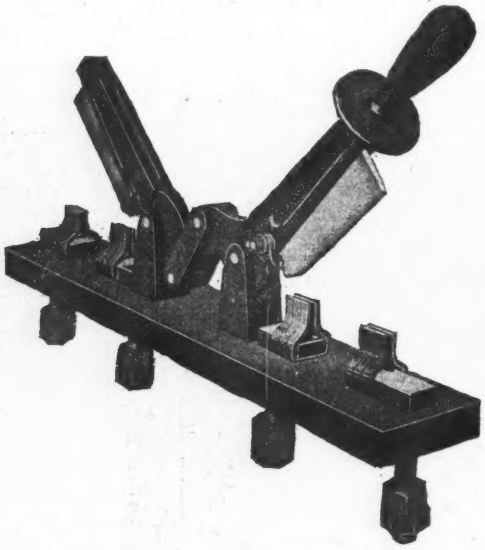


FIG. 3.—"PEEL" TANDEM DOUBLE-POLE SWITCH.

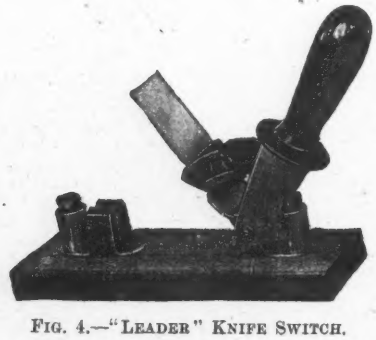


FIG. 4.—"LEADER" KNIFE SWITCH.

switch is shown in fig. 3; it consists of two knife switches connected by a strong link, and so arranged as to occupy the minimum lateral width on a switchboard. Fig. 4 illustrates the little "Leader" switch, which is also of the knife type, and occupies but little space; it is arranged to give a quick break and to hold off, and is made for currents from 15 to 30 amperes, single or double-pole.

One of the various patterns of the "Salford" ironclad switch and fuse is shown in fig. 5. The case is lined with an insulating coating and provided with Uralite arc shields, and a locking strip

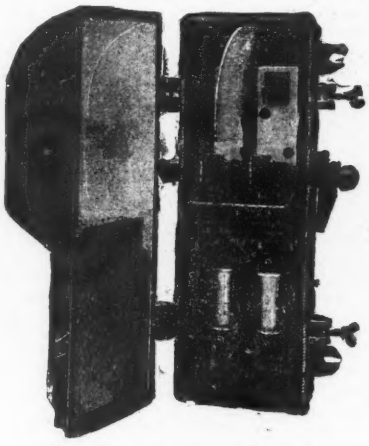


FIG. 5.—"SALFORD" IRONCLAD D.P. SWITCH AND FUSE.

on the cover prevents the case from being opened unless the switch is off. The fuses are enclosed in separate chambers, completely surrounded with insulating material, so that an arc cannot be struck between poles or to earth. These are made for from 15 to 200 amperes, double or triple-pole.

We illustrate also the Record patent automatic battery switch, which is of the differential type, closing the charging circuit when the dynamo voltage is about 10 per cent. above that of the battery, and opening it when the current falls to zero, or reverses, as desired. The switch is of the polarised type, and the permanent magnet is strengthened by the charging current; mercury cups are used for

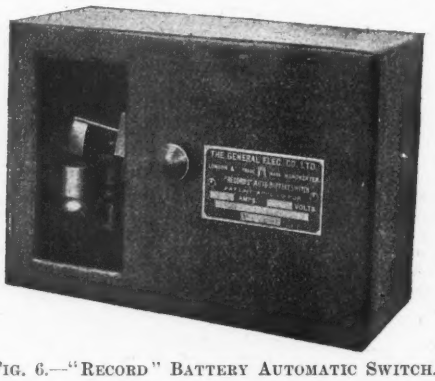


FIG. 6.—"RECORD" BATTERY AUTOMATIC SWITCH.

the main contacts. When the switch is closed, the fine-wire coil is short-circuited, and only a low-resistance series coil is left in circuit, holding the switch on. The switch is made for currents from 10 to 200 amperes.

These items are only a few of the numerous patterns shown in the company's new catalogue, sections X and Y.

THE KINGSWAY TIME BALL.

BY the courtesy of Messrs. S. H. Benson, Ltd., and Mr. F. Hope-Jones, of the Synchronome Co., we were recently enabled to inspect the mechanism of the time ball which has been erected on the dome of Messrs. Benson's lofty building in Kingsway. The ball is a conspicuous object, and is dropped precisely at each hour during the day by an electric impulse from Greenwich Observatory, transmitted over the lines of the Standard Time Co., Ltd., thus providing accurate time for the whole of Kingsway. We have often commented on the deplorable lack of accurate and reliable public clocks in the metropolis—a deficiency which reflects discredit upon the authorities responsible for the public service; it is true that the City Corporation requires all new public clocks to be synchronised with Greenwich, but this is only trifling with the subject, for the great majority of public clocks were erected before this regulation was introduced, and the inaccuracy of the watchmaker's window clock is a matter of notoriety. All such clocks should be brought within the regula-

tion, without exception, otherwise they constitute a public nuisance. The *Times*, in a strong article on Wednesday, emphasised the necessity of this reform.

Messrs. Benson's time-ball affords a means of correcting the vagaries of the uncontrolled and mendacious "time-keeper," and should prove a boon to the neighbourhood. It is, we believe, unique in that it falls hourly. Naturally, it was found necessary to provide means for its automatic operation; time balls which fall only once a day can be set up by hand, but this one is raised by an electric motor, and is entirely independent of manual attendance.

The whole of Messrs. Benson's extensive premises, as well as other buildings in Kingsway, are equipped with the Synchronome electrical time service, controlled by a master clock, which in turn is corrected every hour by the Greenwich signal; the same impulse is utilised to actuate the time-ball, by means of an electromagnet in the pendulum case.

The time-ball is 4 ft. in diameter, and is carried on a cross-head projecting through slots in a cast-iron mast on the dome; the cross-head is supported by a steel rod, guided by anti-friction pulleys, and raised by steel wire ropes attached to a casting at its foot. These ropes are carried over a wooden pulley, about 2 ft. in diameter, mounted on a shaft which is driven by a ¼-H.P. motor through double-reduction worm gear; each reduction has a ratio of 1 : 100, so that the total reduction is 1 : 10,000. The hoisting drum makes about ¾ of a revolution in raising the time-ball to its highest position, at which point a prong clutch on the driving shaft is thrown out of gear by the action of a spiral cam, allowing the drum to recoil slightly; the drum is prevented from running back, however, by a catch engaging a projecting bar. The motor is simultaneously cut out by a switch actuated by the drum in its recoil. The time ball is then ready to receive the signal of release from Greenwich; this, by means of a relay, connects a powerful solenoid to the electric lighting mains, and the core of the solenoid knocks off the trigger, allowing the ball to drop. In order to prevent shock due to the fall, heavy counterbalance chains connected by ropes over pulleys to the lower end of the rod are lifted as the rod descends, thus bringing the latter to rest smoothly. At the same time the motor cut-out is closed again by the rotation of the drum, leaving the motor circuit ready for the next operation; the closing of this circuit at the proper times is effected by one of the "Programme Clocks" of the Synchronome Co., which is ordinarily used to ring electric bells at pre-arranged times. The ball is lifted slowly soon after the half-hour, and remains up until the hour is signalled.

The whole of the apparatus was devised by Mr. Hope-Jones, and forms an entirely novel and unique installation.

BUSINESS NOTES.

Electrically-Propelled Van.—We give herewith an illustration of an electrically-propelled motor van which has recently been put into service by its makers, THE INDIA-RUBBER, GUTTA-PERCHA AND TELEGRAPH WORKS CO., LTD., of Silvertown. It has a four-wheel drive which, amongst other things, gives a better tractive effort, and greatly minimises the chance of skidding on greasy roads. There are two motors (one on each axle) which

ELECTRICALLY-PROPELLED VAN.

are so arranged that the van can be driven on one motor only should the other fail. Great attention has been given to the electrical details to ensure the highest efficiency, and the van has been running with great smoothness during the short time it has been in use. The company are prepared to build vans for special work to suit purchasers' requirements; to erect charging plant complete for any number of cars to work from existing electricity supply, or from a self-contained generating set; to fit up garages complete with battery charging plant and necessaries for proper maintenance of battery and car, and to work out systems of maintenance and running generally to suit special conditions.

Private Meeting.—LUDWIG LEHMANN, merchant, 68 Basinghall Street, E.C.—Consequent on a circular dated the 9th inst., and issued by Mr. James Mortimer, accountant and auditor, of Victoria Buildings, 37, Queen Victoria Street, E.C., a large number of creditors attended at the Manchester Hotel, Aldersgate Street, on Friday, the 13th inst., in order to have a statement of affairs, which it had been stated was being prepared, submitted to them. At the hour appointed for the meeting, however, Mr. Mortimer addressed those present, and said he hoped they had not been inconvenienced by attending, because he had now to report that the meeting convened for that afternoon would not after all take place. It appeared that a bankruptcy petition had been presented against the debtor, and the petition would be heard at the Bankruptcy Court on the 25th inst., and it was the debtor's intention to consent to a receiving order being made. He (Mr. Mortimer) was sorry that he had not been able to spare them the trouble of attending, but the matter had only been decided that morning when the debtor had resolved on the step that had been taken. In these circumstances it was impossible to hold a meeting, and he could only ask them therefore to disperse. Several creditors asked who had presented the petition, and Mr. Mortimer replied that it had been presented by Mr. James Patchett, ironmaster, of Oakworth, Trench, Salop. Other creditors asked whether Mr. Mortimer had any particulars of the liabilities or the assets, but he replied in the negative, saying that he had no papers with him. Asked that a list of creditors should be given, Mr. Mortimer replied, "By all means get them if you can, but not from me." Another creditor suggested that those present should hold a meeting on their own account, and Mr. Low, who represented one firm, said that Mr. Mortimer might at least give them some figures as to the present position. Mr. Mortimer said that the debtor was not present, and all he had instructed him was that he would consent to the receiving order on the 25th inst. A creditor: When was the petition filed? Mr. Mortimer said it was a very old petition indeed, and one that had been on the file for a very considerable time. He pointed out that in this matter he was in the debtor's hands, and he could not give more information than he had. He would tell them, however, that the liabilities were in the neighbourhood of £12,000, but beyond that he was not disposed to go. A creditor: What are the assets? Mr. Mortimer: I have told you; beyond that I am not disposed to go. A creditor pointed out to Mr. Mortimer that he had come a considerable distance in order to attend it. If Mr. Mortimer knew that this was being done, surely he could have acquainted people at a distance by wire, preventing this unnecessary trouble. Another creditor said he had come from Liverpool on the same matter, and he expressed astonishment at this treatment of the creditors. Mr. Mortimer said he fully appreciated all that these gentlemen said, but until that day he had not the remotest idea that the debtor was going to consent to a receiving order. Originally the debtor wanted a meeting of creditors to be called, but now he said that he did not want the matter proceeded with, and to that extent, therefore, he (Mr. Mortimer) was in the debtor's hands. Mr. Hawkins, of Messrs. Poppleton & Appleby, said he represented creditors for approximately £3,000 in this matter, and for his own part these creditors, or a number of them, looked upon this matter as a very serious one, and they were determined that the estate should go into the Bankruptcy Court, and that it should be fully investigated. Those same creditors would be glad to have the co-operation of other creditors, and if the debtor did not consent to a receiving order on the following day, they might take it that another petition would be put upon the file. Mr. Mortimer, replying to other creditors, said he was really not in a position to say more. At the eleventh hour, when he was prepared with all his papers, the debtor had given instructions that this meeting must not be held, and in these circumstances he was powerless to do anything. At the same time, he was willing to assist the creditors as far as he could, and he pointed out that he was in no way antagonistic to the interests of creditors. Answering a creditor, he added that he would see the debtor that day and would advise him of the creditors' wishes in regard to the petition. Asked on what date the petition had been put upon the file originally, Mr. Mortimer replied, amidst some laughter, that he believed it was about a couple of years ago. The petition had been adjourned several times.—A creditor suggested that Mr. Hawkins now took the chair at that meeting.—Mr. Mortimer, interposing, said that he did not think he could allow that, as he did not think it was in order. That was his meeting, and he had already said that it must prove abortive. If they desired Mr. Hawkins to take the chair, Mr. Hawkins could entertain them in his own office.—Mr. Hawkins said that he had satisfied himself that the petition referred to was actually on the file. It was true that it had been on the file two years, and the hearing of it had been adjourned no less than 12 times.—Subsequently Mr. Mortimer, in reply to a creditor, said he believed there were plenty of assets, although the value of them might be somewhat problematical. In reply to Mr. Hawkins, he added that he would endeavour to induce the debtor to do everything in his power to expedite the bankruptcy proceedings. The meeting then broke up. At the conclusion of the meeting, Messrs. Poppleton & Appleby, chartered accountants, of 4, Charterhouse Square, E.C., were instructed by a number of the principal creditors to investigate the matter, and they are now doing so.

Coronation Illuminations.—We have already made allusion on several occasions to the excellent opportunity that the Coronation festivities of next June will afford manufacturers, electricity suppliers, contractors, and others. In days gone by electricity was not nearly so capable of meeting illumination requirements on great public occasions as it is in 1911, owing

to the remarkable progress that has taken place during the last few years. We hope that everybody who ought to be interested in the matter has his plans well forward. We are aware that a number of manufacturers of electrical devices have programmes in preparation. The first complete catalogue, or collection of special designs suited to the occasion, has reached us this week from the GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, London, E.C. It consists of a 20-page book of designs, almost the whole of which are executed in attractive colouring, including glass crowns, metal torches, festoons, letters in Japanned metal troughing or crystal beading, shields, stars, "Pixielite" festoons, illuminated panels, both the simple and the elaborate, and many other devices. "Pixielite" strip is detailed, as are also a number of flashers. Accompanying the catalogue is a price-list giving prices corresponding to the reference numbers in the book. A supplement to the catalogue illustrates and prices a variety of switches, switchgear, cut-outs, lampholders, ceiling roses, time switches, and other accessories intended for illumination purposes. We have no doubt that large numbers of firms who are expecting to transact a good deal of business of this kind will want copies of these lists, and we are asked to state that such can be obtained by sending a trade card and request to the company. The General Electric Co., Ltd., lay stress upon the importance of ordering this class of material early, otherwise deliveries cannot be guaranteed, though they have prepared for a very large demand.

Fires.—THE BAT METER CO., LTD., of Eden Street, Hampstead Road, N.W., report that considerable damage was caused by a fire which occurred on Saturday last in their test room, but orders will be filled with very little delay.

A serious fire broke out at the premises of MESSRS. BRIGHAM AND COWAN, ship repairers and engineers, Wapping Street, South Shields, on the 10th inst. The flames were first seen in the power station at the works but they spread rapidly, and the place was eventually gutted. The whole of the electrical plant, which not only supplied the dock but all the machinery in the works and yard, was totally destroyed. On the morning of the 11th inst. connection was made between the Corporation system and the dock plant, and enabled the firm to resume some of the work in the dry dock.

Diesel Oil Engines.—MESSRS. WILLANS & ROBINSON, LTD., have recently received orders for four Willans-Diesel oil engines, each to develop 268 brake H.P., for driving direct coupled alternators. Two of these engines have been ordered by the Alianza Co., Ltd., London, and two by the Rosario Nitrate Co., of London. In both cases the consulting engineers are Messrs. Strain and Robertson, of Glasgow.

Book Notices.—*Engineers' and Erectors' Pocket Dictionary: English-German-Dutch.* By W. H. Steenbeek. London: Whittaker and Co. Price 2s. net.—This little book decidedly fills a want; the Dutch language has hitherto received little attention from technical lexicographers, and as the author says, an English engineer erecting machinery in Holland or Germany, will find this work of great assistance to him. The arrangement is alphabetical as regards English only, the other languages occupying parallel columns; in this respect full advantage of the opportunity has not been taken, for the English user who desires to know the meaning of a foreign technical term will not easily be able to localise it. Perhaps the deficiency will be remedied by further issues, with the other languages alphabetically arranged.

From the *Indian and Eastern Engineer* Co., Ltd., 50, Fenchurch Street, London, E.C., we have received a 36-page pamphlet entitled "India," in which a writer evidently thoroughly well versed in most things relating to that vast country, gives a good deal of information that should be most interesting and useful to anybody contemplating a visit—brief or prolonged—thereto.

"Oil Engines—Stationary and Marine." By W. A. Tookey. Fifth edition. London: Percival Marshall & Co. Price 1s. net.

"*Bulletin* of the Société Belge d'Electriciens." November, 1910. Brussels: Hotel Ravenstein.

"The School of Mines Quarterly." Vol. XXXII, No. 1. November, 1910. New York: Columbia University. Price 50 cents.

"*Bulletin* Scientifique de l'Association des Eleves des Ecoles Speciales." December, 1910. Liége: *Imprimerie Moderne.* Price 75 fr.

"The Physical Review." Vol. XXXI, No. 6. December, 1910. Lancaster, Pa.: The Review Offices.

"Logarithms for Beginners." By C. N. Pickworth. Third Edition. London: Whittaker & Co. Price 1s. net.—With the exception of minor corrections, this edition resembles its predecessors. The demand for a third edition speaks well for its merits.

"The Slide Rule." By C. N. Pickworth. Twelfth Edition. London: Whittaker & Co. Price 2s.—The author has added descriptions of new slide rules, and a section explaining the meaning of certain gauge points and other marks often found on slide rules. The work is too well known to need recommendation.

"Bulletin of the Association des Ingenieurs Electriciens." December, 1910. Liége: Rue Saint-Gilles, 31. Price 3 fr.

Dissolutions and Liquidations.—TURBINE CORPORATION, LTD.—This company is winding up voluntarily, as it cannot, by reason of its liabilities, continue the business. Mr. P. Mason, 64, Gresham Street, E.C., is liquidator.

DURELL & CO., electrical engineers, 58, Fenchurch Street, London, E.C.—Messrs. E. A. & S. L. Durell have dissolved partnership. Mr. S. L. Durell will attend to debts, and continue the business under the same style at the same address.

For Sale.—The Grimsby Corporation has for disposal a number of single and double-carbon open-type "Gilbert" arc lamps. See our advertisement pages in this issue.

Bankruptcy Proceedings.—W. H. STEED, motor and electrical engineer, Stamford Street, Kingsway, Altrincham.—Adjudication order made January 9th at Manchester. First meeting, January 25th; public examination, February 17th; both at Manchester.

H. J. BURDETT, electrical engineer and contractor, 32, Earl Street, Coventry.—Trustee (A. Cripwell) released December 1st, 1910.

A. H. GIBBINGS, engineer, Liverpool.—Trustee (E. D. Symond) released November 28th, 1910.

Trade Announcements.—THE GLOBE ELECTRIC CO., LTD., of London, have appointed Messrs. Walters & Co., Ocean Chambers, Waterloo Street, Birmingham, to act as their agents for Birmingham and the Midlands. A representative show of "Multax" flame lamps will be available at their address shortly.

According to the *Australian Mining and Engineering Review*, the UNION ELECTRIC CO. (OF AUSTRALIA), LTD., has just been formed in New South Wales, with registered offices at the corner of Wynyard and Margaret Lanes, Sydney, and with branch offices at 33, William Street, Melbourne. The capital of the company is £15,000 issued in £1 shares. This company will take over the already large interests in Australia of the Union Electric Co., of England, and will operate in Australasia as the sole agents of that company. The new company has the agencies for many important English and Continental firms. The management of the Australian company's affairs is in the hands of Mr. Harry G. Such, in Sydney.

THE REASON MANUFACTURING CO., LTD., have appointed Messrs. Davidson & Blackadder, of 50, Wellington Street, Glasgow, to be their sole agents for the south of Scotland.

MR. C. W. COCKRAM, electrician and dealer in lighting goods, of Barnstaple, has removed his business from Bear Street to 112, Bouthport Street.

We are asked to state that the offices of MESSRS. ANDRE CITROEN AND CO., makers of the Citroën machine-cut helical gears, have, in consequence of the large increase in their business, been removed to larger premises at 27, Queen Victoria Street.

MR. J. W. BULLEY, who was with Messrs. Laing, Wharton and Down, at Holborn Viaduct and New Bond Street, and, later, was electrical engineer to Messrs. A. & F. Pears, Ltd., has now been appointed by Messrs. Accles & Pollock, Ltd., of Oldbury, Birmingham, manufacturers of the "Oldbury" system of steel conduits and fittings, to take charge of their London office. The company's office and warehouse have been removed from Ruskin House, Rochester Row, to 39, Queen Anne's Chambers, Westminster, S.W., the telephone number being "227, Westminster." Large stocks of all the running lines will be kept.

THE WESTERN ELECTRIC CO., LTD., have opened a branch office at Standard Buildings, City Square, Leeds, and have appointed Mr. W. H. Wraith, who has been a member of their staff for over ten years, to be district engineer and representative.

MESSRS. WARD & GOLDSTONE, Springfield Lane, Salford, Manchester, have now built another storey on to their works, and are duplicating their cable and wire-covering plant. The new plant will be in working order within three or four weeks, placing the firm in a better position for quick execution of wire and cable orders than in the past.

We understand that Mr. F. M. Part, who represented the HART ACCUMULATOR CO., LTD., as a traveller in the North of England, terminated his engagement at the end of last December.

Calendars and Catalogues.—From the JANDUS ARC LAMP AND ELECTRIC CO., LTD., of Hartham Road, Holloway, N., we have received a wall calendar, the artistic merit of which we are sure will make it a favourite. The name of the firm is quite neatly and unobtrusively placed. The crayon sketch of a lady is the feature which compels attention, the calendar slips are there for use as necessity demands, and last of all one finds the name of the firm—which is the correct order of importance to be observed in choosing a calendar which one desires to adorn an office wall for an entire year.

THE CARBON TOOL CO., Albany Road, Coventry.—Small pamphlet giving prices and illustrations of diamond tools for truing, dressing and shaping emery, corundum, carborundum, alundum, and other kinds of abrasive wheels. Copies can be obtained on application. The company have just removed to the above address, and all communications should be sent there.

MESSRS. JAMES SPENCER & CO., Chamber Ironworks, Hollinwood, near Manchester.—A neat wall calendar with twelve tear-off sheets, on each of which a half-tone illustration of a machine tool appears above plainly printed dates for the month.

LIGHTING and POWER NOTES.

Australia.—A proposal by the Sydney electrical engineer to popularise the small motor is that a fixed charge of 4s. per month per H.P. and a charge of ¾d. per unit, be made for such apparatus. Mr. Mackay anticipates some loss in revenue at the start, but has hopes that the 12,000 H.P. of hired motors now supplied will shortly be doubled. The Committee favours the scheme.

The Tasmanian Parliament has passed the Bill authorising the Devonport Municipality to raise a loan of £4,000 for extending the

electric lighting system. A poll of ratepayers will be taken before the work can be proceeded with.

The Sydney City Council has passed the following recommendation of the Electric Light Committee:—"That, in accordance with a report by the city electrical engineer, dated September 1st, 1910, the lighting of all the streets and lanes in the city by electricity which are at present lighted by gas be carried out, at an estimated cost of £26,100; the estimated revenue (crediting the electric light department with £23 for each arc and £3 7s. 6d. for each incandescent lamp per annum) being £10,718 2s. 6d."

The Council has laid a scheme for street lighting before the North Botany Council, which is to be considered by the ratepayers.

The Rockhampton Harbour Board has been authorised to supply electricity within the area under its control.

According to the official returns of the Government Statist, there were in Victoria 13 electric light and power stations in 1909, and the quantity of electricity supplied was 16,471,368 units. An indication of the growth of this industry is afforded by making a comparison with the year 1900, when the amount was 6,100,519 units.—*Australian Mining and Engineering Review.*

The Melbourne Electric Supply Co. is shortly to install a 2,000-KW. Willans-Siemens turbine at Melbourne and a 300-KW. Belliss-Peebles set at the Geelong station.

Ashford (Kent).—The East Ashford R.D.C. has decided to oppose the application of the East Kent Electric Supply Co., Ltd., for a prov. order for electric supply, on the ground that the proposed supply does not cover the whole of the scheduled parishes.

Beaconsfield.—The U.D.C. has objected to certain clauses included in the prov. order for electric supply, being applied for by the Uxbridge and District Electric Supply Co.

Belfast.—The electrical exhibition in the Ulster Hall, under the auspices of the Corporation, is proving a great success, thousands visiting it daily to see the latest in cooking, heating and driving machinery by electrical power. The venture has proved that these exhibitions do more good than desultory advertising; many exhibitors have booked more business in the opening three days than they expected to book during the exhibition. So great is the interest in cooking by electricity that many ladies have booked their seats up to the end of this week, when the exhibition closes. Mr. J. E. Dawson, the organising secretary, is in charge.

Continental Notes.—AUSTRIA.—A powerful syndicate which has just been formed with a capital of 100,000,000 kr., intend, says the *Oesterreichische Wochenschrift*, to build a generating station of 100,000 H.P. capacity on the left bank of the Danube, opposite Wallsee. To procure the needful water-power, it is proposed to divert the Danube near Au into a navigable canal of 125-metre breadth, which is to be constructed, the canal eventually terminating on the Süttinger Arm of the Danube, near Wallsee. The erection of so large a supply station will naturally have a stimulating effect on local industries, besides providing surplus power for railways and tramways; but many competent persons regard the project with considerable misgivings, as it is considered likely that the floods—to which this neighbourhood is notoriously subject—will probably be more severe when the work is carried out.—*Elektro. und Machinenbau.*

Vienna is about to establish its first refuse destructor in connection with one of its electrical stations.

FRANCE.—La Société des Forges et Acieries du Nord et de l'Est is reported to be considering the question of establishing an electrical steel making plant at its works at Jeumont.

HUNGARY.—A central electric lighting station is to be established in the town of Nagykata.

Croydon.—The London, Brighton and South Coast Railway Co. has come to certain arrangements with the B.C. regarding the eventual extension of the electrification to East Croydon, which, by the new system, will be connected with London Bridge and Victoria. This venture, however, is stated to be subject to the success of the electrification schemes at present in hand, and to suitable facilities being obtained. The Council on Monday decided to enter on two agreements—(1) to supply current for the lighting of the sidings and goods yard at Norwood Junction (where a depôt for the electric rolling stock is being erected; and (2) giving sanction to the London Electric Supply Corporation to provide the Brighton Co. with energy for power and lighting inside the shops. Answering questions, Ald. Betteridge (chairman of the Lighting and Electricity Committee) said the arrangement would ensure a business profit on the current sold, and would not entail the erection of any additional buildings or machinery at the electricity works.

Dundee.—The electrical engineer has been authorised to remove many of the electric lamp standards in the principal streets, and to replace them by span wires fixed to the buildings on either side. More modern lamps are to be introduced in High Street and Murraygate.

The question of lighting the harbour with electricity was touched upon at a meeting of the Harbour Trustees. Mr. A. R. Mechan asked if the question of substituting electricity for gas, in order to avoid risk of fire, had been considered.—Mr. T. B. Taylor replied that, so far as he knew, there had been no fire caused by gas at the harbour. The question of electricity might be considered in connection with the baths, but the lighting of the whole harbour by electricity was too big a question to be gone into at that time.

Eastry.—The R.D.C. has decided not to consent to the application of the Sandwich, Deal and Walmer Electricity Supply Co. for a prov. order for E.L. At the same time the Council will offer no obstacle to mains being laid through the district, which is a necessity for the carrying out of the scheme to supply Sandwich, Deal and Walmer.

Eastwood (Notts.).—The surveyor to the D.C. has been instructed to prepare an estimate of the mileage of the parish and the probable cost of a transforming station with a view of installing a system of electric lighting in place of gas.

Edinburgh.—The Corporation Electric Lighting Committee has had before it a letter on behalf of the Committee of creditors for the Marine Gardens making a proposal for the settlement of the electric lighting account. A former proposal that the city should take shares in the reconstruction of the company had been declined as outside city business. The latest proposal was an offer of 10s. in the £ for the account of £272. Several members were disposed to accept the settlement, but ultimately the matter was remitted to a sub-committee

Emsworth (Hants.).—The Lighting Committee of the U.D.C. has under consideration the question of the relighting of the whole town, and the adoption of electricity for the purpose.

Glasgow.—Recently it was reported to the T.C.'s Electricity Committee that the unexhausted borrowing powers of the electricity department amounted to £15,000, and that application would require to be made to the Secretary for Scotland for consent to borrow a further sum to meet additional capital expenditure for electricity purposes. The engineer and the treasurer have now submitted a statement which shows (1) that the amount which the Corporation has already obtained authority to borrow was £2,000,000, of which sum £250,850 has been repaid by way of sinking fund; (2) that the estimated capital expenditure in connection with the existing works from June 1st next until May 31st, 1914, will be approximately:—

(*a*) For additions to existing buildings	£1,000
(*b*) For boilers, economisers, pumps and piping in the two existing generating stations	25,400
(*c*) Additional transforming plant for sub-stations ...	10,900
(*d*) For additional mains and cables	182,000
(*e*) For meters	10,800
Total	£230,100

and (3) that in the event of the new generating station, proposed to be erected on the ground recently acquired on the west side of Dalmarnock Road, being proceeded with, the cost of the necessary buildings, plant and mains in connection therewith would be not less than £280,000. The Committee has recommended that application be made to the Secretary for Scotland for his consent to borrow £500,000 for electricity purposes.

The Electricity Committee has approved of the proposal by the engineer to have protective gear fitted to eight of the largest H.T. feeders at a cost of £80 per feeder.

Goole.—The company promoting an electric lighting scheme for the town has informed the Council that it has decided to postpone application for a prov. order until next year.

Guston.—The P.C. has approached the Dover T.C. with regard to a supply of electricity for the parish for public lighting. The extension of mains would cost from £800 to £900, and the matter has been referred to the electrical engineer.

Hull.—The Bridges Committee of the Corporation has included in its estimates for next year a sum of £3,000 for the electrification of Sculcoates Bridge over the River Hull, which is worked at present by hydraulic power. It is also proposed to substitute electricity for hydraulic power on the other bridges in the city

Hyde.—A Sub-Committee of the Corporation has been appointed to consider a memorial from the Executive Committee of the Hyde Tradesmen's Association, in reference to the inadequate lighting of the principal thoroughfares in the town.

Japan.—We learn from Tokio that a scheme is under consideration to put down a plant for the utilisation of the water power of the River Chikugo, in the Province of Kyushu, for the generation of electrical energy. It is estimated that 20,000 H.P. will be available, of which 5,000 H.P. will be taken by the Wakamatsu Foundry, and the remainder by various collieries and other undertakings.

Kendal.—The T.C. has decided to apply to the L.G.B. for a loan of £1,450 for additional plant, &c., at the electricity works.

Leigh.—A sub-committee has been appointed to consider and report upon a scheme submitted by the borough electrical engineer, for further extensions of plant in connection with the electricity undertaking, at an estimated cost of £5,560.

The town clerk has been instructed to call the attention of the South Lancashire Tramways Co. to the defective lighting of the whole of the tramway routes within the borough.

London.—LEWISHAM.—The Works Committee of the Lewisham B.C. has received further applications from the South Metropolitan Gas Co. and the South Metropolitan Electric Light and Power Co. for permission to erect lamps on the public footway. The Gas Co. applied for this permission as regards the front of shops extending from Nos. 50 to 210 and from Nos. 85 to 179, High Street, Lewisham, and from Nos. 1 to 11, Lewis Grove. The Electric Light Co. applied in respect of Nos. 50 to 120, High Street, Lewisham. The application of the Gas Co. is to be granted, subject to the usual protective conditions

in respect of Nos. 50 to 164 and Nos. 85 to 179, High Street, Lewisham.

BERMONDSEY.—The units generated during December were 502,126, as against 369,851 in the corresponding period of 1909. As a result of the Committee engaging an expert to value the electricity undertaking the final figures come to by the Assessment Committee are as follows: gross, £7,500; ratable, £2,500. The rating previously in force was £2,693 gross and £1,776 ratable.

SOUTHWARK.—The District Secretary of the Electrical Trades Union wrote to the Council drawing attention to the fact that the recent vacancy for a charge engineer at the electric light station was only advertised by a typewritten notice outside the station. The Union protested against the insufficient publicity given. The Electric Light Committee, in reply, point out that the appointment in question was originally for a temporary charge engineer to assist at the station during the absence of permanent staff on vacation. This temporary vacancy was advertised by the electrical engineer in the technical papers during the Council's summer vacation, and 90 applications were received for the post. A properly qualified man was selected, but it so happened that soon after he had commenced his duties a vacancy occurred on the permanent staff, owing to one of the charge engineers obtaining a better appointment. The services rendered by the temporary man having been of a satisfactory character, and possessing, as he did, some knowledge of the station, the Electric Light Committee recommended his appointment to the vacancy, and this appointment the Council confirmed.

Manchester.—Joint conferences of the Gas and Electricity Committees are being held in order to adjust, if possible, some of the differences existing between these competitive Committees. The Gas Committee's grievance is that, while it pays 2 per cent. of its capital annually in rate aid, the Electrical Committee only pays about ¼ per cent., thus enabling it to sell at nearer cost price than the former Committee. The question is an involved one, which will come before the T.C.

Mirfield.—The U.D.C. has applied to the L.G.B. for a loan of £1,058 for electric light purposes.

Oldham.—The Electricity Committee has decided to get out specifications for a new 1,200-KW. turbo-generator, &c., at an estimated cost of about £8,000.

Pateley Bridge (Yorks.).—The R.D.C. has decided to support the application of Messrs. Christy Bros., Ltd., for a prov. order for electric lighting in the parishes of Bewerley, and Highand Low Bishopside, and to the use of overhead wires.

Radcliffe.—The U.D.C. has decided that the charge for current for the tramways to Bury T.C. shall be 1¼d. per unit, instead of 1⅜d.

Richmond-on-Thames.—At the last meeting of the Board of Guardians, a letter was read from the Richmond Electric Light and Power Co., to the effect that the terms under which the contract of 1905, with regard to the supply to the workhouse and offices was granted, had not been carried out by the Guardians. In view of this, the company from April 1st, 1911, would render their accounts on the following basis:—Annual consumption 10,000 units and upwards, 4d. per unit; 5,000 units and upwards, 5d. per unit. The agreement of 1905 was granted in consideration that the use of the supply would be extended to the whole of the workhouse buildings, the consumption estimated therefrom being 20,000 units per annum. In arriving at the new scale of charges, the Guardians would see that, in order to enable them to take full advantage of the increased efficiency of the metallic-filament lamps, the company had put the annual minimum consumption which would obtain the 4d. rate at a very low figure, and that by carrying out the original proposal of extension there could be no doubt that the advantage of this rate would be obtained. The matter was referred to the Finance Committee.

St. Margarets-at-Cliffe.—Another effort is being made to secure a supply of electricity for the parish. Some time ago the Dover T.C. propounded a scheme for the extension of mains from the town, but owing to the cost, the L.G.B. would not sanction a loan. A private company is now to be formed with the idea of obtaining a supply of energy in bulk from Dover, and the electrical engineer has been instructed to prepare a report on the matter. It is suggested that the supply should be given at 3½d. per unit from the borough boundary, to which point overhead cables would be erected.

Swinton and Pendlebury.—The Council has authorised an application to the L.G.B. for a loan of £4,000 for electricity mains, extensions and services. Of this amount £1,700 has already been incurred in extensions necessitated by the growth of the undertaking, and the balance is for extensions during the next two or three years.

Twickenham.—At the meeting of the Council on January 12th, the Lighting Committee reported having considered letters from the Brentford Gas Co. and the Twickenham and Teddington Electric Supply Co. as to the terms upon which they would be prepared to undertake the street lighting of the district. The terms quoted by the Gas Co. were slightly in excess of the cost of the present system. The terms quoted by the Electric Supply Co. for 100-C.P. lamps, including supply of energy, maintenance of electric lamps and setting time switches, were slightly less than the amount at present paid by the Council for lighting the street lamps with gas, but for any period less than ten years the company would only be prepared to light the portion of the district in which mains were at present laid, and its capital expenditure, estimated at £3 10s. per lamp, would have to be incurred by the Council to cover the cost of connecting up the lamps with the electric light mains, converting the lanterns and supplying lamps, fittings and time switches. It was decided by the Council that advertisements be issued inviting tenders for supplying gas or electric current for lighting the whole or portion, not being less than 200, of the street lamps in the district for a period of 12 months.

Whitehaven.—The T.C. has decided to undertake the lighting of the King Street Arcade at 24s. per 100-C.P. lamp per annum, including maintenance. The installation is to be provided by the owner.

Whitwood (Yorks.)—A special meeting of the Urban Council has been held for the purpose of considering the new electric lighting scheme, and it has been decided that the charge for electricity to the consumers through a meter shall be 3d. per unit. The Council has also undertaken to supply, fix and maintain any number of electric lights, up to a maximum of four per house, at the rate of 4d. per unit plus 10 per cent. for meter rental and subject to a written agreement, but it is understood that this is only in reference to an experimental installation for a maximum of 50 houses. The Council offices, pumping stations, surveyor's house and hospital buildings at the No. 1 sewage farm are to be lighted by electricity, and the surveyor has been instructed to put the work in hand at once.

Winchester.—Following the meeting of the T.C., which took place on Thursday morning of last week, when the purchase of the electric lighting undertaking was resolved upon by 13 to 1, a town's meeting of ratepayers was held in the evening of the same day, with a view to expressing an opinion upon the subject. The town clerk briefly explained the legal aspect of the matter, showing that the provisional Bill was obtained in 1895 and in 1897, it was transferred to the company subject to the condition that by giving 12 months' notice the T.C. could acquire the undertaking on its capital value. This notice having been given in 1910, the Corporation was committed to the purchase. After considerable discussion with a strong element of opposition, a resolution approving of the Council's action was carried by a large majority.

TRAMWAY and RAILWAY NOTES.

Aberdeen.—The Corporation Tramways Committee has considered the question of a tramway up Market Street, and a sub-Committee was appointed to meet the Harbour Commissioners in connection with the doubling of the track on Upper Quay. A proposal for a tramway to Footdee was also discussed, and Mr. Pilcher, the manager, and the burgh surveyor, were instructed to prepare a report on the matter.

Argentina.—Senor Juan Carosio, of Buenos Ayres, having obtained the concession for an electric power station and tramway system in Asuncion, the work will be commenced at once, and the Cia. Industrial de Electricidad del Rio de la Plata, representatives of the well-known European manufacturers, Franco Tosi (Leguano) and the A.E.G. (Berlin), who have already erected many important plants in Argentina, will be entrusted with the work of construction and supplying the machinery, &c.—*Review of the River Plate.*

Croydon.—The Croydon and Southern District Railless Electric Traction Co. is seeking powers to run railless trams between Croydon and Merstham and Caterham. The matter is being considered by the Parliamentary Committee of the Surrey C.C., which has reported that the proposals are far reaching in character, and would require careful consideration.

The B. of T. has sanctioned the borrowing of £2,875, repayable in 15 years, for the provision of five additional single-truck double-deck cars for the Corporation tramways.

Holywell.—The R.D.C. has decided te support the Mid-Flintshire tramway scheme of Mr. Butler.

Heckmondwike.—The U.D.C. has decided to ask the Tramway Co. if it can see its way to construct a line of tramways from Heckmondwike to Dewsbury, *via* Walkley Lane.

Southampton.—The tramways manager asked his Committee for permission to instruct the makers, Messrs. Dick, Kerr & Co., to put in hand the remainder of the equipments for the new cars. The Council required six more sets, and it also required the same number of trucks. Of the two makes of long-wheel base trucks which were tried, he had found that the one made by the United Electric Car Co., of Preston, was the better. These, however, had not been running long enough to make it absolutely certain that they are better, taken all round, than the shorter Brill trucks. The wear on the tires certainly did not seem to be greater in spite of the longer centres. The riding of the car, however, was infinitely better, and he believed that the long base truck in the end would prove to be better than the short base, especially as they were gaadually eliminating or improving their smaller radius curves.

(*Continued on page* 107.)

THE MANUFACTURE OF CARBONS.

By WILLIAM CLACHER, F.C.S.

A FEW years ago the writer was appointed chemist at the carbon works of the British Aluminium Co., Ltd., in Greenock, and he has since then taken an interest scientifically and industrially in aluminium, its production and use. He will detail at length his experiences in the industry, one of the newest, and one to which a great deal of attention must be given ere the solid foundations requisite are securely laid.

Much progress has already been made during the short life history of aluminium as a metallic substance commercially obtainable, but much remains to be done to make its production economical and profitable to those concerned in it. The improvements required are mainly chemical. I particularly refer to such a process as the production of the metal direct from the bauxite, omitting the costly process of purifying the alumina; a reduction in price of the product will then ensue sufficient to make it a serious competitor in commercial metal markets.

I shall here deal principally with the manufacture of the carbons, and shall give the general methods of work used at Greenock. At Kinlochleven the methods have been somewhat modified, due to improvement in the plant; but the principles underlying both systems are the same. The difference in favour of the carbons produced at Kinlochleven is due to the new furnace there erected, which is of the regenerative type, giving a much higher temperature than the Greenock tunnel furnace.

The properties essential to a good carbon are :—

1. High conductivity.
2. Non-liability to crack.
3. Efficient contact arrangement between the carbon and the metal conductor.

The characteristics accompanying (1) are :—(*a*) A good ringing sound when struck; (*b*) a high specific gravity and low porosity. The specific gravity of different forms of carbons varies thus :—

Calcined anthracite has a specific gravity of			...	1·80
Calcined petroleum coke	,,	,,	...	2·00
Kilned retort carbon	,,	,,	...	2·05

Taking blocks made from these carbons with the same porosity, the retort carbon block has the highest conductivity; the petroleum carbon block has the next highest conductivity, and the anthracite carbon block the lowest.

I am dealing with anthracite calcined at 1,000° C., not at 3,000° C.—that is, non-graphitised anthracite.

The outline of the process for making the carbons is—

1. The petroleum coke is first calcined to remove volatile matter, and increase the specific gravity and conductivity.
2. The calcined material is pulverised.
3. The pulverised material is mixed with the binding medium in a steam-jacketed mixer.
4. The mixed mass is moulded.
5. The block is kilned in the furnace, the kilning taking five days. After this the blocks are cooled, brushed, and stocked ready for use.

The petroleum coke is obtained in the distillation of shale oil; it is the residue left in the iron retorts. There is left in it from 5 per cent. to 13 per cent. of volatile hydrocarbons, which are not driven off with the heavy oils. There is also a small amount of inorganic material averaging ·2 per cent. Most of the latter is in the harder parts; the softer and more porous parts are almost ashless. I have analysed pieces with a difference of over ·5 per cent. between the separate portions. Surface colouring I have not found to indicate the presence of inorganic material; such carbons are none the less considered of lower grade.

The pieces as they come from the oil works are usually of large size. This is good for stacking purposes. There is at the same time a percentage of smalls and dust, varying with the quality of the coke, the softer cokes having by far the largest amount. This is a serious matter to the Aluminium Co.; as the small dust chokes the calciners and is not easily worked away, only a certain amount can be added with each charge of coke.

The calciners are vertical rectangular brickwork chimney-like constructions: the coke is put in at the top and the calcined material drawn out with long rakes at the bottom. The charges are given every two hours, and a half charge is drawn every hour; two cwt. was the charge in the Greenock calciners. The time the coke takes to travel from the top to the bottom is five hours.

The temperature in the calciner is approximately 2,000° C. at its hottest part. The calcining is a very costly and, as at present carried out, wasteful process, for 30 per cent. of the coke put in is burned away during the process; the volatile matter in the coke before calcining averages 8 per cent., so that 22 per cent. of carbon is used to raise the temperature to 2,000° C., representing fuel at £3 5s. per ton—considerably more costly than the best smokeless coal.

Calcination has been carried on in horizontal retorts; these are more expensive at first, but they are much more economical with the coke, 20 per cent. being the loss usually found with them. In cases where the calcination was effected in a current of producer gas, the loss was little more than the percentage of volatile matters in the material; 15 per cent. was the figure obtained from 10 per cent. volatile in the coke, and the temperature is nothing like as high as in the vertical retorts, not exceeding 1,000° C. The reports on anodes made from coke calcined thus were of a satisfactory character; the specific gravity of the carbon was slightly less than that calcined in the vertical calciners, 1·95 being obtained.

Calcined coke was also once made by packing the blocks before entering the tunnel furnace with it, and then passing it through; the coke swelled up, and the blocks thus packed were unusable.

In the vertical calciners experiments were begun before I left, with the object of saving the excessive loss by passing producer gas into the calciners, and using that in place of the coke to get the required temperature. The work was not far advanced when I left, and I am not aware that anything on these lines has been worked at by the Kinlochleven staff.

After calcination, the coke at Greenock contained ·7 per cent. inorganic material, consisting of ·5 per cent. silica, ·15 per cent. oxides of iron and alumina, and ·05 per cent. soluble sodium salts.

At Kinlochleven the arrangements of the stores for the oil coke, and the transporting and grinding machinery, have been totally altered. In addition, breakers to crush the coke to the size required for calcining have been erected; vertical rotary crushers and high-speed vertical grinding mills are used, and the sieving machinery is more up to date. At Greenock the breaking of the coke was done by men with hammers.

The grinding of the calcined oil coke is done in two stages: (1) An initial crushing to pass through a $\frac{3}{8}$-in. mesh; (2) a grinding to get the correct gristing of the powder. This gristing is an exceedingly important item; the amount of fine dust and large must be properly proportioned to get the block with the highest specific gravity and least porosity.

A good gristing is :—Through 100 mesh, 40; 60 mesh, 15; 30 mesh, 20; 16 mesh, 15; between 16 and 8 mesh, 10.

The cost of grinding at Greenock was 3s. to 4s. per ton; there was a large loss of carbon in the open pan-mill, and the machine for the finer grinding, amounting to 7 per cent. of the total. This loss is done away with when using the new machinery.

The supply of petroleum coke, a by-product in the paraffin industry, is dependent on the quantity of shale oil distilled, and this is strictly limited in amount.

In view of an expected increase in the demand for aluminium, and a consequent greater need for a good carbon, a search was made for likely sources. Of retort carbon, which is used for making the furnace linings, the supply is limited

by the quantity of coal gas made. Of anthracite there is an unlimited store, and provided the inorganic contents were within the limits of the supply of calcined oil coke, this was considered a possibly valuable article.

The limits of impurity allowed were ·5 per cent. silica and ·2 per cent. iron oxide ; this was the average analysis of the ash contents of the kilned blocks at the time, in the year 1904.

A great amount of work was performed on this for a period extending over three years. After that, the work was stopped for a time. After I had left the company I continued the experimental work, and after overcoming some of the difficulties left unsolved in the Greenock factory, I patented the process (Patent No. 2,071—1909).

The following forms of carbon were treated at Greenock :—

1. The returned blocks from the Foyers furnaces.
2. Retort carbon.
3. Anthracite, Scotch and Welsh.
4. Bituminous coal.
5. Graphite.

The work on (5) was carried on exclusively after I had left the company, and I shall not allude to it further here.

1. The returned blocks from Foyers contained approximately 2 per cent. inorganic constituents, of which a little over 1 per cent. was silica and iron oxide ; this was crushed to pass through an eight-mesh sieve, with the usual gristing, and, after treating, the inorganic contents were reduced to ·5 per cent. I give an analysis of the untreated and treated material :—

	Before.	*After.*
Ash	1·56 %	·53 %
Soluble	·33	·17
Silica	·46	·14
Iron oxide	·26	·14
Oxide of aluminium	·39	—
Diff. (CaO MgO SO_3)	·12	—

2. Gas retort carbon as used at Greenock contained from 2 to 4½ per cent. of inorganic constituents. Crushed to pass through an eight mesh, and of the usual grist, the inorganic was reduced from 3 per cent. to ·75 per cent. Analysis :—

	Before.	*After.*
Ash	2·35 %	·68 %
Soluble	·10	—
Silica	·91	·20
Iron oxide	·62	·26
Oxide of aluminium	·41	·08
Lime	·17	—
Magnesia	nil	—
Sulphur trioxide	·11	—
Difference	·03	—

Another analysis :—

	Before.	*After.*
Ash	2·87 %	·71 %
Soluble	·08	—
Silica	1·13	·16
Iron oxide	·86	·19
Oxide of aluminium	·60	·36 *

* Soluble and oxide of aluminium.

3. Scotch Anthracite.—The seams tested contained from 4 per cent. to 12 per cent. inorganic. I give analyses of some purified ; in this case of somewhat smaller grist, the whole passing a 16 sieve :—

	Before.	*After.*
Ash	9·24 %	1·81 %
Silica	5·00	·83
Iron oxide	1·06	·22
Oxide of aluminium	2·02	—
Lime, magnesia, sulphate and soluble	1·16	·19

Ash	4·99 %	1·08 %
Silica	2·47	·49
Iron oxide	·46	·08
Oxide of aluminium	1·69	·19
Lime	·09	·32
Magnesia	·05	
Sulphur trioxide	·08	
Difference	·15	

Ground to pass through a 60 mesh, the totals were reduced in proportion. Analysis :—

	Before.	*After.*
Ash	6·50 %	1·25 %
Soluble	·17	included in diff.
Silica	3·55	·38
Oxide of iron	·88	·05
Oxide of aluminium ...	1·55	·31
Difference	·35	·51

With Welsh anthracite I got from a seam analysed :—

	Before.	*After.*
Ash	2·08 %	·57 %
Silica	·78	·20
Oxide of iron	·32	·12
,, aluminium	·43	·12
Soluble and difference ...	·53	·13

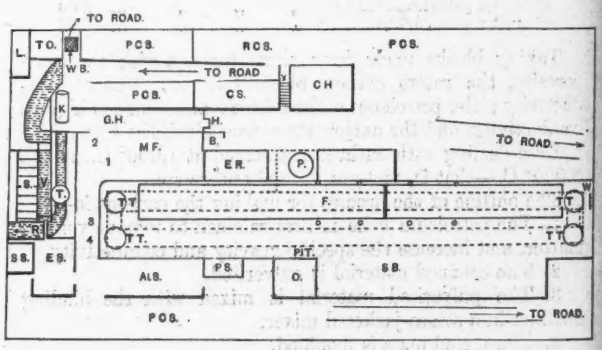
The material was milled to pass a 16 mesh.

4. With a good bituminous coal containing 3 per cent. ash, the silica was reduced to less than ·1 per cent. The iron oxide was not removed, and work was discontinued on that account.

The process used was a hot digestion with a strong caustic solution, and the removal of the silicates, sparingly soluble in caustic, with a weak acid solution—iron oxide being subsequently extracted.

From the grinding mills the fine powder is taken away to the store hoppers, from which it is transferred to the mixing machines; these are seen in fig. 1, and are of the steam-jacketed kneading type, with reversing gear for changing the direction of motion. The temperature of the mixture when ready for discharging is 90° C. In the mixers shown the tipping is effected by means of an upright screw ; in the large new mixers for Kinlochleven a worm quadrant and screw is used in place of the upright screw. The mixers in the illustration hold a charge of 300 lb. of mixture. The hopper for weighing the carbon is seen over the right-hand mixer, and the pitch-weighing tank over the left-hand mixer. The amount of pitch used is 22 per cent. of the mixture; it is a medium hard brand, and has volatile constituents to the extent of 50 per cent., as volatile is determined quickly; only 40 per cent. volatile goes away during the slow kilning.

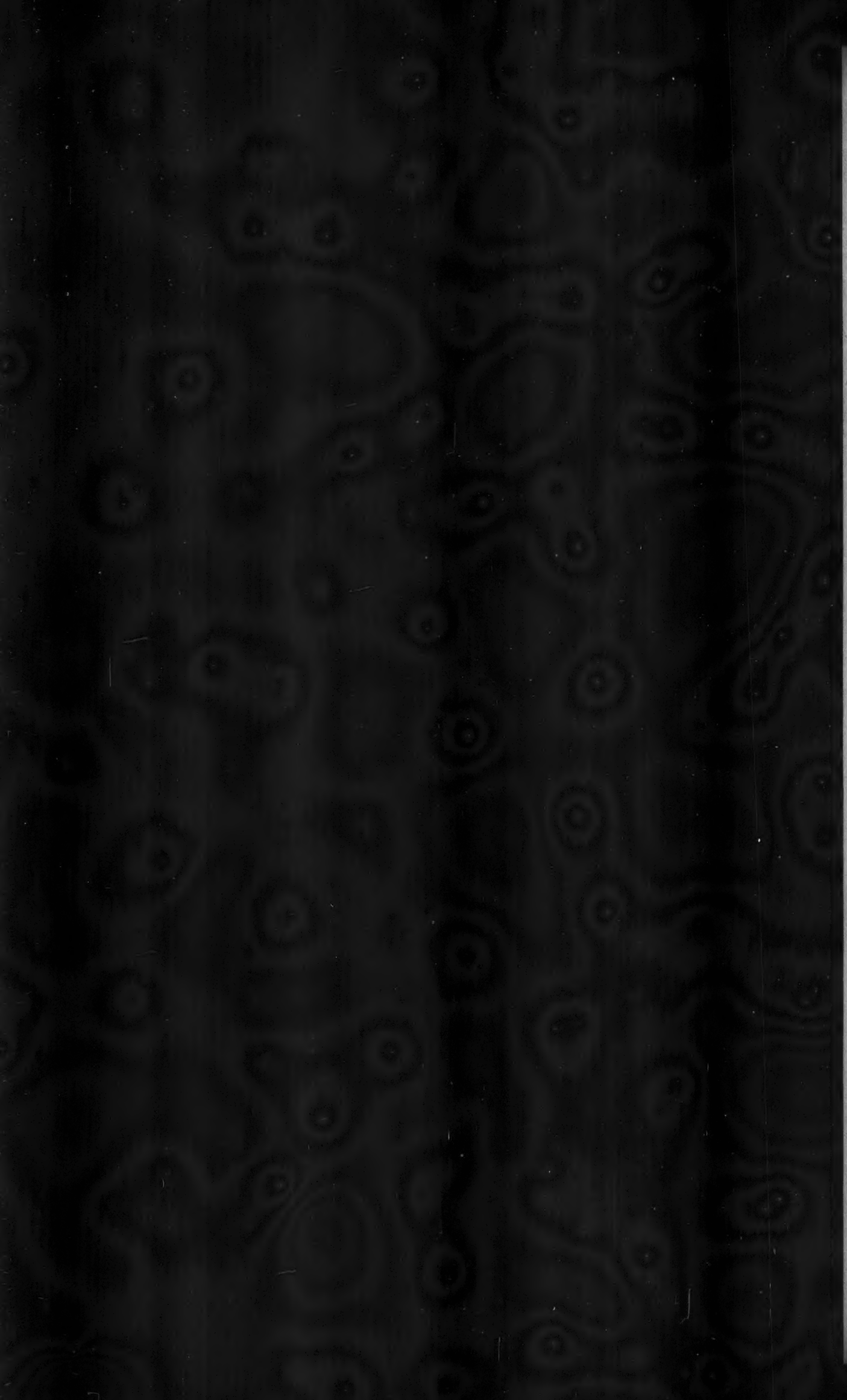
The tar used for making the linings for the electric furnaces is much softer, containing up to 60 per cent. volatile as determined by the quick method. This lining for the furnaces was made at the mixers in Greenock, bagged, and sent to Foyers, where it was heated and rammed in the furnaces at the side and bottom, and then baked with current passed through before charging the furnaces with the electrolyte. The life of the linings varied from a few days to months. Latterly the mixture for the furnaces was made at the electric reduction works, saving the trouble and expense of the reheating. For making the tar to the required degree, I used an instrument for measuring its fluid quality at the temperature of mixing (115° C.), the time a given weight took to run out of an orifice giving the indication required. I found tests so performed were usually in agreement with the volatile determination, and a test of the fluid nature is of more value as a criterion for the binding material in the tar than is the percentage of volatile matter in the semi-liquid.



SKETCH PLAN, SHOWING GENERAL ARRANGEMENT OF CARBON FACTORY.

INDEX :—PCS, Petroleum coke stock; RCS, Retort carbon stock; CH, Calcining house; GH, grinding house; H, Hoist; MF, Moulding floor; F, Tunnel furnace; TT, Turn-tables; W, Winch : SB, Stock finished blocks; PS, Stock pitch ; CS, Coal ; B. Boiler ; ER, Engine-room ; P, Producer ; L, Laboratory ; TO, Time office ; ES, Engineers' shop ; SS, Smiths' shop ; ALS, Aluminium stock ; O, Offices ; S, Flight of stairs : V, Overflow ; R, Runaway from turbine ; T, Water turbine; WB, Weighbridge ; K, Kilns for drying carbon ; 1, 2, 3, 4, Positions of Figs. 1-4.

The bending point of a slab of pitch 3 in. long and ½ in. square is a very good test for the pitch. This test is certain, the determination of the volatile content is anything but certain ; I have found that when the greatest care is taken the limit of accuracy of volatile determination is such that a determination of that kind is not a standard of value.



The second illustration shows the arrangement of the mixing and moulding floor. On the right-hand side are two melted-pitch tanks; they are wrought-iron vessels, steam-heated by internal coils. The pitch is lifted up by means of a small windlass and emptied into the tanks as required. A third tank was afterwards added; this was a steam-jacketed vessel, and worked more satisfactorily than the two shown: the leakage of the joints in the coils caused frothing and overflowing of the tanks heated with the internal coils.

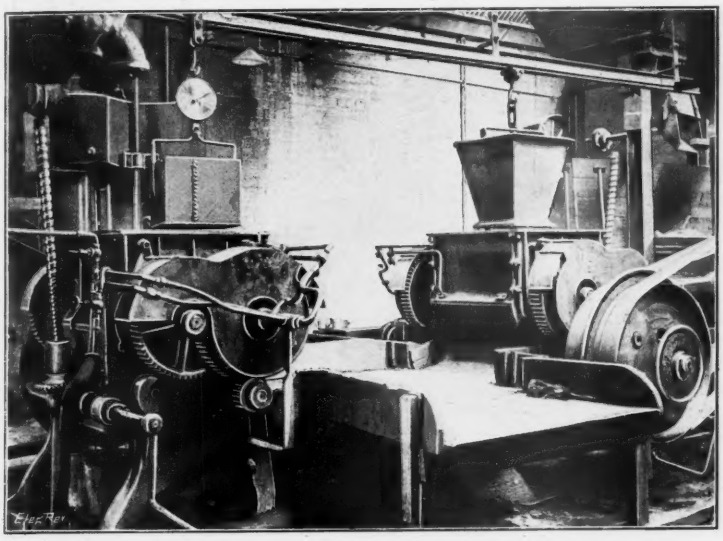


FIG. 1.—WERNER & PFLEIDERER MIXING MACHINES.

In the centre are the two mixers and the store hopper containing the carbon; on the left hand are the hydraulic moulding machine and some of the moulded blocks.

The mixture, when tipped from the mixer to the platform, is transferred in scoops to the container of the mould, which is in the centre of the machine. When the mould is full, the water valve is opened, the container rises, and the block is formed. When the gauge registers 1 ton to the sq. in. the valve is shut, and the run-away valve opened, the container lifted and the block discharged; it is taken away and put on the floor, there to remain for a day to harden, previously to being packed in the trucks for putting through the furnace. Half a ton to the square inch will form a good block. One ton is usual, and as much as four tons has been used.

It is not possible to make a good block with mixture that is cool, and arrangements are made to work with as little stock of mixture as possible. The capacity of the machine illustrated was 40 blocks an hour. The Kinlochleven machine is more complicated, and is designed for a larger output.

The blocks are 10 in. square, with cutaway corners, and are 12 in. high. Those shown in the illustration are flat topped. This has been improved, and for some time all the blocks have been made with the top rounded. The top of the block, efficient only as a means of making contact, is thus reduced in weight, and consequently a rounded-top block of equal weight to a square-top block has more carbon usable for the reduction of the alumina.

The contacts seen in the blocks are of mild steel and are moulded in the blocks, the internal end being forked; the forks are thoroughly cleaned and coated with pitch previously to being put in the clamp for moulding. It is noticeable that the contacts are not central in the block. When the contact is made at the furnaces, the point of suspension becomes central, and the blocks hang vertically without strain.

The form of contact shown is the best between the carbon and the metal; but these are very expensive to have in stock. A large number is required, and the wear and tear on them is great. The later forms of contact are made by screwing the metal into a moulded thread in the block; the number of contacts required in stock is much lessened, and the wear and tear comparatively inappreciable.

The weight of a block before kilning averages 70 lb. with the claw; after kilning, 66 lb. with the claw. The claw weighs 8½ lb. The loss of 4 lb. in the block corresponds to 8 per cent. on the block, and 40 per cent. on the pitch used.

The arrangement of the pitch tanks at Kinlochleven was much altered, and in no way resembles the Greenock arrangement. This was on account of the much larger output that was expected.

When made, the blocks are stored till they have hardened somewhat, and are then placed in the trucks for calcining. At Greenock the blocks were stored on the moulding floor; a few days' stock was kept. At Kinlochleven larger storing accommodation is arranged for.

The trucks seen in illustrations 3 and 4 are oblong, and made of firebrick; they are mounted on bogies. The blocks are placed, 42 in number, in a truck, and are packed with fine ashes free from dust; the metal contacts are covered with fireclay covers, and the fireclay covers are completely hidden with the ashes. The truck is then pushed into the furnace, and at the same time a truck with the kilned blocks is pushed out of the other end of the tunnel by the same movement, which moves each truck in the furnace one stage on. A hydraulic ram is used for this purpose. As soon as the truck with the unkilned blocks is in and the truck with the kilned blocks out, the iron furnace doors are dropped and the furnace is at normal again.

Producer gas is the fuel used for heating the furnace, this being made in a Mason producer; the coal found best for that purpose was a Lanarkshire singles containing 3 per cent. to

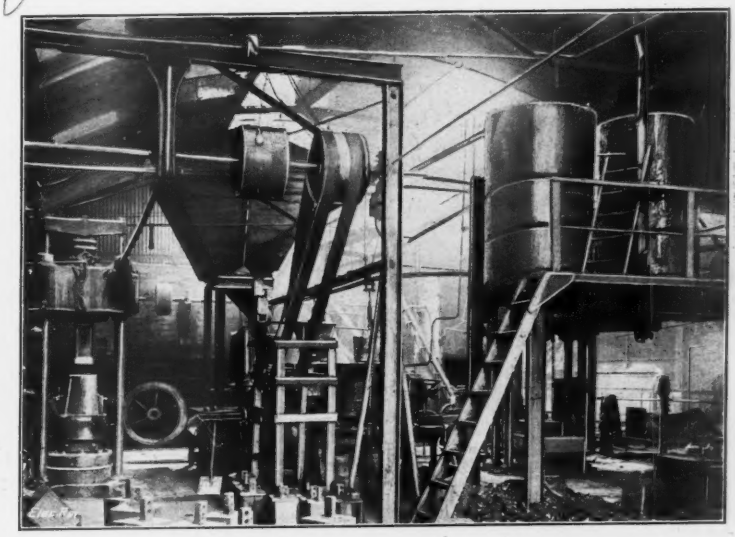


FIG. 2.—MIXERS AND PITCH TANKS.

5 per cent. of inorganic and 30 per cent. volatile constituents; the analysis of the gas made is:—

Carbon dioxide	4·0
Carbon monoxide	22·0
Hydrogen	16·0
Methane	4·0
Oxygen	2·0
Nitrogen...	52·0
	100·0

The flues from the producer to the furnace require cleaning once every eight days; the regulation of the quality and quantity of the gas also require attention. When I went to Greenock the producer was consuming 40 tons of singles a week. By regulating the feed and the steam and air I got the consumption down to 27 tons per week. At the same time, a more constant temperature was produced.

The furnace is seen in illustrations 3 and 4. It is 200 ft. long. On either side are four gas valves. These are regulated to give an even temperature over the middle of the furnace. The escaping gases heat the incoming trucks, and the outgoing truck is somewhat cooled before being ejected. The maximum temperature at the top of the truck is usually 1,150°, at the bottom of the truck 700° C. The latter is the temperature to which the bottoms of the anodes made at Greenock were kilned. This is doubtless a disadvantage for the purpose to which the furnace is now applied—the calcination of alumina to be used at the electric furnaces.

The furnace at Kinlochleven is built of firebrick and is of the type used at Witton, in that it is regenerative, the chambers in which the articles kilned are cooling being used to heat the air for the combustion in the hot chambers; the temperature normally attained as a maximum is said to be 1,400° C., and the same time is taken for the cycle of operations as at the Greenock factory—5½ days. The chambers are filled with the boxes containing the blocks, which are packed, I understand, as at Greenock, with fine ashes; they are stacked one above the other in the chamber. The boxes are of fire-clay, and are made at Kinlochleven. When the chamber is filled to the requisite capacity, the opening is sealed with brickwork, and this chamber is then made the last in the circuit of the gases passing through it previous to entering the chimney flues. The accompanying plan, fig. 5, gives an idea of the arrangement of the chambers.

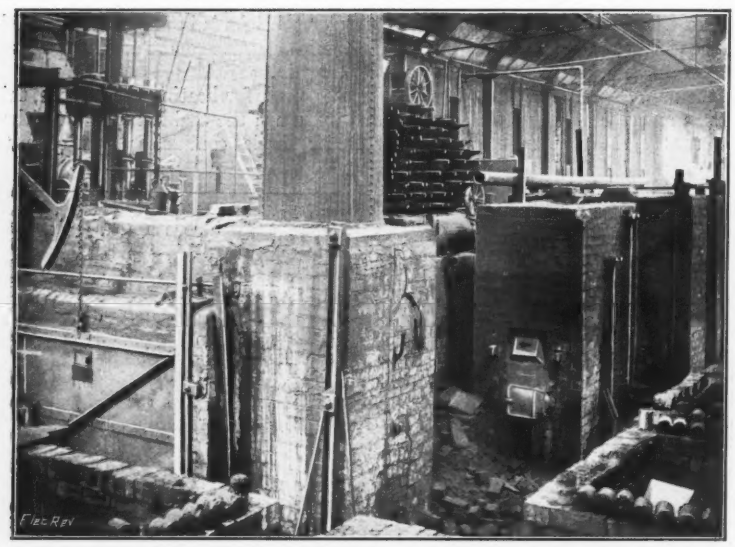


Fig. 3.—Heating End of Furnace.

The blocks kilned in this furnace are said to be much more efficient at the electric furnaces than the Greenock kilned ones.

At Foyers during the past few years the Greenock blocks gave a yield of 1 lb. aluminium for ·7 lb. carbon used; the most that is expected is ·64 lb.

A great amount of trouble has sometimes been caused by the burning of the blocks by the air at the electric furnaces; this serious reduction of the efficiency of the carbon was gone into, and many coatings were given the blocks to prevent the oxidation, whitewash amongst others. I have reason to think this difficulty is solved. Cracking of the blocks at the electric furnaces is a trouble, due to the block not being to standard. A block should last from 100 to 140 hours, and when conditions are normal in the furnace the time factor is most valuable. When blocks last less than 100 hours they are not classed good.

The specific gravity of the Greenock blocks was 1·63 after

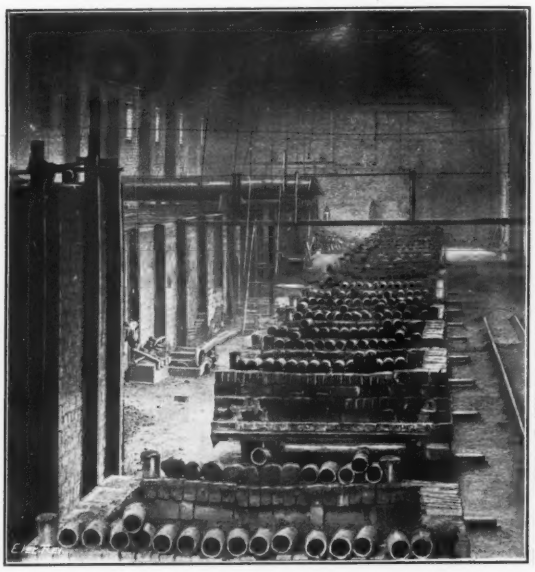


Fig. 4.—Tunnel Furnace and Row of Trucks.

kilning, and the porosity 20 per cent.; different parts of the Greenock blocks had often different porosities, and considering the difference in temperature between 1,150° and 700°, the temperatures at the top and floor of the truck, this is not to be wondered at. Before kilning the specific gravity was 1·53.

I experimented with the making of blocks from a very heavy pitch with less than 40 per cent. volatile matter. Blocks thus made in a gas-heated mixer were harder than the usual block; their conductivity I did not have tested.

The Manufacture of Aluminium.—Aluminium is commercially produced at the present time by a reduction process from the previously purified ore. This reduction is effected in electric furnaces. The part the electric current takes is the production of the intense local heat needed to reduce the oxide of the metal to the metal.

The electrolyte, consisting of alumina and its flux cryolite, is melted, and the oxide at the point of contact of the carbon anodes becomes reduced, the carbon oxidising and burning away. The metal thus produced sinks to the bottom of the furnace, which is carbon-lined, and is drawn off thence.

This metal, from the purity of the material used—the carbon being 99 per cent. and the alumina 99·9 per cent. purity—is of very high percentage; over 99·5 per cent. is very usual.

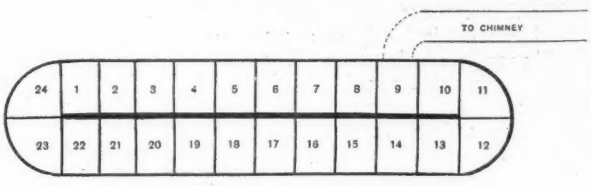


Fig. 5.—Plan of Regenerative Furnace.

From the aluminium reduction works the ingot metal is taken to the mills and foundry, to be worked into sheet and alloy, and also for castings.

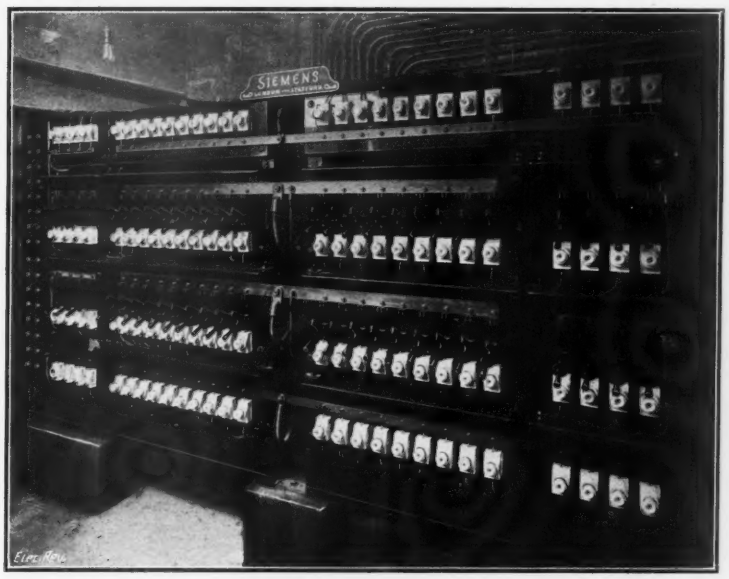
The 10-in. square carbon blocks are arranged in sets of 12 in the electric furnaces. The electric current is continuous. The dynamos are 50-volt machines.

The metal as it comes from the furnace is afterwards melted, and the pure metal, free from any mechanical admixture, is moulded in ingots. These ingots are bagged, about 20 ingots to the bag, and dispatched to the foundries and mills.

The metal was much used at steel works for adding to the molten steel to remove oxide, the whole going away in the slag process. This is not as much in use as it was four years ago. The cost of producing the metal can be allocated thus :—

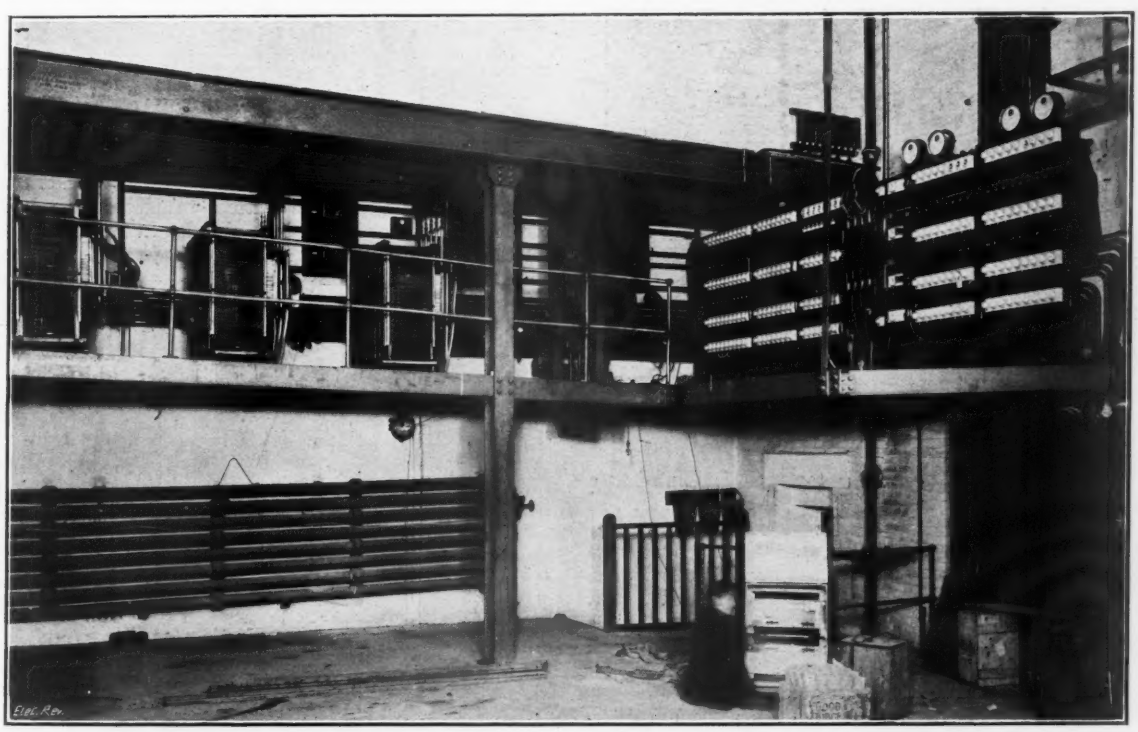
Energy	100s. per ton.
Carbon	130s. ,,
Alumina	560s. ,,
General expenses and profit	560s. ,,
	1,350s. per ton.

Portable Projector.



Front-of-House Main Switchboard.

Siemens Electrical Equipment of the Palladium Theatre (see next page).



Palladium Theatre : Stage Switchboard and Dimmer Resistances.

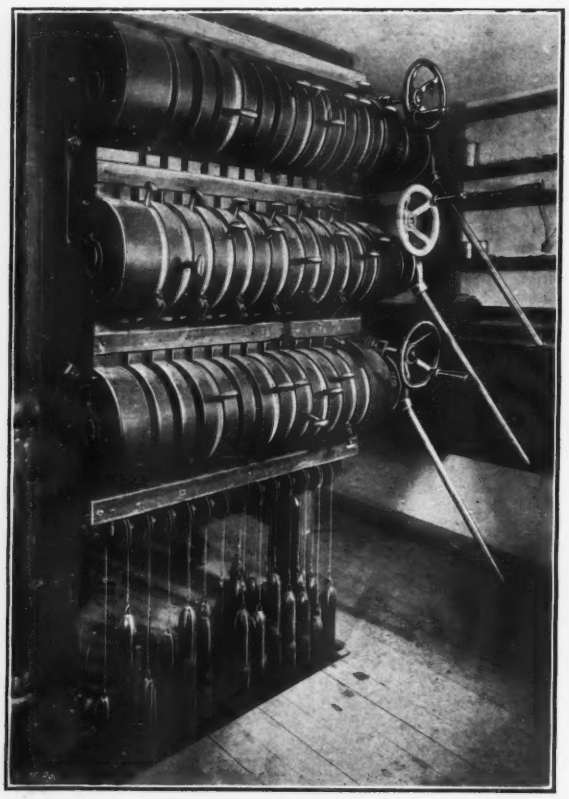
The plate for the bottom of the furnace is of cast-iron, and somewhat of the form of a grid. The interspaces are filled with carbon which is rammed, and the whole plate covered. This form makes the contact between the carbon lining of the furnace and the cable much more effective.

The resistance of the carbon blocks is tested at the furnace. The carbon blocks are consumed away, the gases going to the atmosphere ; hydrofluoric acid gas is also evolved from the cryolite used.

The power used is water-power, the most economical source of energy.

The alumina is purified from the bauxite by the Bayer process—solution in caustic soda and precipitation therefrom by addition of some previously precipitated alumina, filtered off and kilned.

Some remarks regarding the process used for obtaining the alumina and the methods of analysing the metal will not be out of place in an article of this class; for information in detail regarding the metal analysis the reader can consult the *Journal* of the Institute of Metals, where the analytical methods are described succinctly. With regard to the production of alumina from bauxite, the mineral is first kilned to expel moisture, then finely pulverised: the finely divided material is mixed with caustic soda of 40 per cent. strength to a fluid mass, and kiered under an internal pressure of 30-60 lb. per sq. in., 100 lb. steam jacketing the vessel. After eight hours, the mass is blown by its internal pressure to a tank, whence the filter presses are charged; the height of the tank above the level of the presses depends on the fineness of grinding. The insoluble matter is termed red mud.



Siemens Stage Regulator.

The mass when blown to the top tank is diluted to a suitable concentration and temperature, so that the wear and tear on the cloths is not heavy.

The filtered aluminate of soda is run to tanks, and some alumina, previously precipitated, is added. After some time the alumina is precipitated, a white semi-flocculent substance.

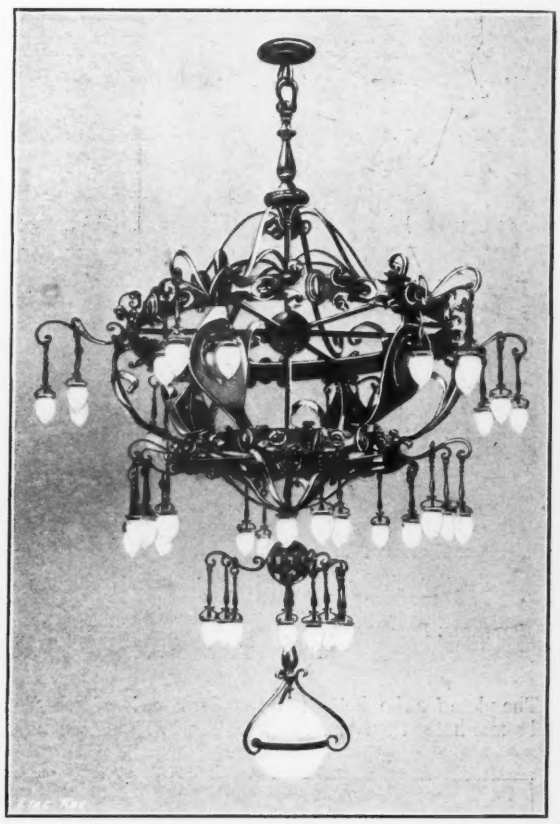
This precipitate is then filtered, washed, partially dried in the press, and calcined in a furnace at a cherry-red heat, after which the hard white amorphous alumina is ready for transportation in bags to the electric furnaces.

In analysing the metal, the impurities alone are determined, the difference being assessed aluminium. Of these impurities the most important are silicon, silica, sodium and iron. In practice the items customarily determined are the iron, and silica with silicon.

With alloys the method of titrating, using standard potassium ferrocyanide for the zinc, and precipitating the copper with ammonium sulphocyanide, and titrating the redissolved precipitate with sodium thiosulphate, I have found to give satisfaction. For details of this method, reference can be made to the *Journal* of the Chemical Society.

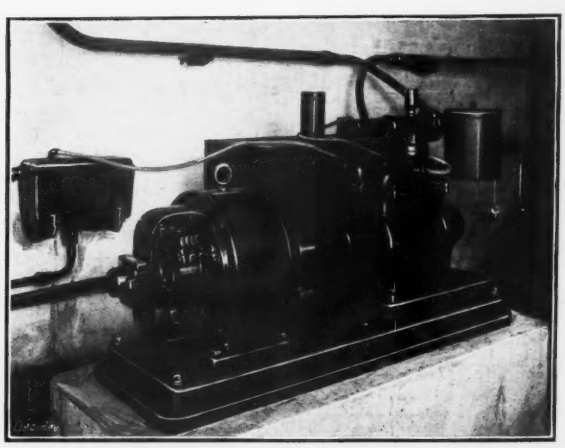
THE ELECTRICAL EQUIPMENT OF THE PALLADIUM THEATRE.

We recently visited the Palladium Theatre of Varieties in Argyll Street, London, to inspect the electrical equipment of this, the newest of the metropolitan places of amusement.



Fifty-light Electrolier.

The establishment has been decorated and upholstered with lavish splendour, and as might be expected, the electrical installation has been conceived on a similar scale of completeness and luxury. The contract was placed in the hands of Messrs. Siemens Bros. Dynamo Works, Ltd., who supplied all the electrical apparatus; the wiring was sub-let by them to Messrs. Rashleigh Phipps & Co. We give herewith some



Vacuum Plant.

illustrations of the equipment, for which we are indebted to the contractors and to Messrs. Siemens Bros. & Co., Ltd., as well as for the following particulars of the installation.

Electrical energy is supplied by the St. James' and Pall Mall Co. on the three-wire system, using 110 volts for the lighting and 220 volts for the motors. Special mains are

brought into the back of the building for the stage lighting, and the front for the house lighting, and a small alternative supply is given by the London Electric Supply Corporation for the latter, in compliance with the rules of the L.C.C.

The electrical equipment of the stage comprises a stage switchboard, a stage regulator and "dimmers," a "special effect" switchboard, an electric stage lift, and the stage fittings, consisting of seven battens, 52 ft. long, each fitted with 250 lamps, 250 footlights, besides "hanging lengths," "bunch lights" and "proscenium lights," making in all over 2,400 electric glow lamps, mostly in three different colours. In addition, there are 18 arc lamp projectors, nine being on the stage and nine in the auditorium.

The electrical equipment in the house comprises a large front-of-house switchboard, a smaller alternative switchboard, an electrically-driven "Vortex" suction cleaner plant, electric fans, and the necessary distributing fuseboard and fan-regulating boards. The electric fittings have been specially designed by Messrs. Siemens Brothers Dynamo Works, Ltd., Fittings Department, Dalston, to correspond with the general style and decorations of the building, and are of the Georgian type. The auditorium is lighted from the roof by means of two 50-light electroliers, each 12 ft. high and 9 ft. in diameter, one of which is illustrated on page 104, as well as by a large number of smaller fittings. Holophane reflectors play a large part in the distribution of light; the Holophane bowls at the foot of the large electroliers contain 100-C.P. "Onewatt" lamps. In addition, there are electric signs, and the exterior of the building is illuminated by 22 flame arc lamps. All the glow lamps are of the Siemens "Tantalum" and "Onewatt" metal-filament types. The total number of glow lamps in the whole building is close on 4,000, and altogether the electric lighting and power equipment represents over 400 H.P. All the electric circuits are protected by Siemens "Zed" fuses, which ensure the security of the installation, owing to the ease and rapidity with which the blown cartridge can be replaced, and to the fact that it is impossible to replace one by another of a larger or smaller capacity. Part of the building is wired with "Stannos" wires, and the remainder with Siemens vulcanised india-rubber-covered wires, ranging from 3/22 to 37/14, drawn into enamelled steel conduits. There are upwards of 30 miles of electric lighting wire installed, and about 8 miles of conduits.

In addition to the electric lighting, there are several telephone systems and electric bell circuits.

The stage switchboard is probably the largest of its kind that has yet been installed in this country; it controls incandescent and arc lamps taking approximately 2,100 amperes at 110 volts. As shown in one of our views on page 103, it is mounted on a platform with the stage regulator, in a position commanding a view of the stage.

In order to comply with the regulations of the London County Council, all the connections have been arranged on the front of the board, and this has necessitated a somewhat special design so as to accommodate the large number of cable thimbles, &c., without interfering with the operation of the switches and fuses. The circuits controlled are grouped into four sections, viz., stage lighting through dimmers, general stage lighting, stage arc lamps, and those front-of-house lights which are controlled from the stage. An additional panel carries the "black-out" switches, by means of which nearly the whole of the lights can be switched on and off simultaneously. There are in all about 90 circuits, and on each are fitted double-pole fuses of Siemens "Zed" type and a single-pole knife switch. A slate panel is provided at one end of the board, having a number of circular orifices in which a stock of spare cartridges is kept, ready for immediate use.

The regulation of the stage lighting in respect of colour, dimming and illumination is effected by the stage regulator, the most important electrical part of a theatre installation. This apparatus centralises the regulation of the whole of the stage lighting fittings, and permits of producing, in each separate group of lamps, at the will of the operator, all desired variations and combinations of light intensities and colours. The dimmer resistances used at the Palladium differ in construction from those usually employed, metal resistances being used in place of liquid resistances. In order to obtain the various light intensities, these regulating resistances are thrown into the circuits leading to the groups of lamps. Owing to the extremely fine sub-division of the resistances, the current may be reduced gradually from its normal strength, corresponding to the full candle-power of the lamps, until the lamps are completely dark; hence every desired variation of light may be obtained between full light intensity and complete darkness.

The adjustment of the resistances is effected by means of regulating wheels which are combined in the mechanism of the stage regulator, all the lamps of one colour in each fitting being always controlled by one of these wheels. The latter are revolved by means of small levers, and are constructed in the form of cord pulleys, over which a cord, which is held in tension by a counter-weight, leads to the sliding contacts of the resistances.

The number of independent wheels in the mechanism depends on the number of fittings simultaneously connected. The most complete regulation is obtained with the largest possible number of fittings distributed about the stage, all of which have each colour separately connected to the regulator. It is then possible gradually to dim the lamps of one colour, whilst simultaneously another colour, which is quite dim, may be increased to full intensity, so that not only is regulation of light intensity achieved, but also a mixture of the colours and a transition from one colour to another with any desired total light intensity.

All regulating wheels for the same colour are mounted in one row, and may be coupled together on to a common spindle in their rear. The coupling device clutches the separate regulating levers with the common spindle in any desired position, so that by turning a single hand-wheel situated at the side, an additional uniform movement of all the coupled levers is obtained, and any desired groups of lamps of one colour may be brightened or dimmed simultaneously. The coupling of the regulating levers is effected by band-brakes which grip the cord-pulleys, whereby the latter are moved all together by the common spindle.

The hand-wheels can also be fitted with a fine regulation, in order to obtain a specially slow and steady movement of all the coupled regulating levers. The cord-pulleys are provided with scales and pointers, which permit of reading off the light intensity at any moment. By this means any particular adjustment of light can be noted and be reproduced later on, as desired.

The total current controlled by the Palladium stage regulators is 1,140 amperes. The number of regulating wheels is 33, these being arranged in three rows of 11 wheels each.

A switchboard for special lighting effects is situated at the back of the stage, for providing lights for properties and effects introduced by the various "turns," as required.

In order to provide a raised platform for special scenic effects, and to facilitate the removal of scenery and properties to the basement, a portion of the stage floor measuring approximately 20 ft. by 10 ft., and supported by substantial iron work, capable of sustaining a load of 20 tons, is arranged as an electrically-driven lift, which is operated by a Siemens electric motor. The latter with its gear is capable of raising the lift with a load of 30 cwt. The control is of the semi-automatic push-button type, with separate push buttons for the up and down journeys. By the arrangement adopted, the lift comes to a standstill immediately the push-button is released, and, therefore, permits of obtaining very exact adjustment of level.

A complete suction cleaning service is installed in the auditorium, saloons, corridors, &c. In connection with this a Siemens "Vortex" suction cleaner is fixed in a basement underneath the stalls, and connected to a system of air pipes, which run to connection points distributed throughout the house. The cleaner machine, of which we give a view on page 104, is directly driven by a 5-H.P. 220-volt motor, and embodies all the special features of the "Vortex" plant—absence of gearing, valves, and reciprocating parts, and practically automatic and noiseless operation.

A number of "lightning" arc lamps are provided, one being fixed on each batten length, alternatively at the right and left-hand ends of the battens. These lamps are connected to a multiple-way switch on the stage switchboard, and when the handle is moved round rapidly the lamps are switched on in rapid succession for the fraction of a second only, whereby a "forked lightning" effect is produced.

The projector lamps are extremely powerful, and are similar in construction to those usually employed for marine work. The larger projectors, of which three are in use in the biograph room at the back of the roof, and two in the projector room in the centre of the roof, take a current of 45 amperes each. The small lamps which are fixed at the sides of the proscenium and on the stage perches, as well as the portable ones, take 35 amperes each.

A switchboard, which we illustrate, is situated in the front part of the building, similar in general design to the stage switchboard, and consists of three sets of panels controlling the general lighting, exterior arc lamps, and that portion of the auditorium lights now controlled by the stage switchboard, but which have to be "blacked out" for certain "turns." Fifty-four circuits are provided for, each of which is fitted with double-pole fuses of the "Zed" type, and a single-pole knife switch. A smaller switchboard connected to the alternative supply is also mounted in the same situation.

There are 14 "Typhoon" fans, about 50 in. in diameter, mounted on the ceilings under the balconies, for assisting in the ventilation of the auditorium, and a number of table fans are provided for the saloons, &c.

The whole of the wiring on the stage and in the auditorium is controlled from some 60 distribution boxes, which are in turn fed from the main switchboards. The distribution boards have several special features, viz. :—The "Zed" fuses and switches are fixed on the enamelled slate panels in an improved manner, so that the back of the slate is free from any drilling, screws or connections. This feature has resulted in the attainment of very high insulation resistance; all terminals, bus-bars and connections are on the front of the slate, and the greatest care has been devoted to securing easy wiring and accessibility. Regulating switchboards for the fans are provided on the walls at the back of the gallery promenades.

The boxes are fitted with Siemens telephone instruments, which are connected to a central-battery exchange in the Louis XV salon; by this means the occupants of the boxes can communicate with the various refreshment rooms, or with each other. Loud-speaking telephones of special design are fitted on the stage, connecting with the Royal Box and the stage manager's office. The instruments on the stage have short trumpets; the speaking is very distinct, and can be heard clearly from a distance of 5 to 10 yards. Intercommunication telephones, of the automatic replacement line-selector type, are fitted in other parts of the house, and on the the stage, for the convenience of the theatre staff.

We are indebted to Mr. W. Gibbons, managing director of the London Theatre of Varieties, Ltd., and Mr. F. J. Humphrey, the supervising engineer to the company, for their courtesy in enabling us to view the complete installation.

ELECTRIC FURNACE EFFICIENCY.

THE December issue of the *Metal Industry* contains a report of a recent address by Prof. J. W. Richards, of Lehigh University, in which attention is called to the lack of scientific data necessary for estimating the efficiency of melting furnaces; the professor strongly recommends that, wherever possible, systematic efficiency tests be made, and the results published for the benefit of all.

The proper basis for real information, so that comparison may be drawn between electric and other types of furnaces, is the measurement of the calorific values of the fuels used, the knowledge of the calorific value of electrical energy, and the measurement of the heat units in a known weight of each of the various metals and alloys, when in a molten state ready for casting.

By assuming that a metal needs superheating 10 per cent. beyond the melting point for practical purposes (for very large amounts 5 per cent. might answer), the following (abridged) table of calories necessary to melt and superheat 1 kilogramme of metal to the point needed for casting, was constructed :—

	C.° melting point.	Latent heat of fusion.	Heat in melted metal. Just melted.	Heat in melted metal. Superheated 10 per cent.
Aluminium	645	100	258	278
Calcium	780	53	186	202
Iron	1,600	69	336	368
Nickel	1,450	68	290	319
Copper	1,058	43	162	176
Zinc	419	23	68	73
Silver	962	24	89	96
Tin	232	14	28	29
Antimony	632	40	74	78
Platinum	1,775	24	89	102
Gold	1,054	16	51	55
Lead	326	4	16	17
ALLOYS.				
50 Tin	—	—	—	—
50 Lead	202	10	19	20
15 Tin	—	—	—	—
85 Copper	—	—	—	130
35 Zinc	—	—	—	—
65 Copper	—	—	—	130
Cast-iron	—	—	—	250
Steel	—	—	—	315

An application of these principles is given, and coke, oil and electricity are compared in the instance of melting one kilogramme of bronze containing 130 calories.

1. *Coke* (calorific value 7,000 calories).—At 100 per cent. efficiency, 130 ÷ 7,000 = 0·019 kg. of coke per kg. of bronze melted is required; or 1 lb. of coke melts 1 ÷ ·019 = 54 lb. metal. If in practice 10 lb. are melted, the efficiency is 18 per cent.

2. *Oil* (calorific value 11,500 calories).—At 100 per cent. efficiency, 130 ÷ 11,500 = 0·0113 kg. of oil per kg. of metal is needed; or one part of oil melts 1 ÷ ·0113 = 88 parts of metal. If in practice 15 parts of metal are melted, the efficiency is 17 per cent.

3. *Electricity* (knowing 1 KW.-hour furnishes 860 kg.-calories).—At 100 per cent. efficiency, 130 ÷ 860 = 0·15 KW.-hours are expended; or 1 KW.-hour should melt 6·7 kg. of metal. If in practice 3·3 kg. are melted, the efficiency is 50 per cent.

To melt 1 lb. (130 lb. calories required), 0·07 KW-hour, or 0·09 H.P.-hour is necessary.

From these figures it appears that—

1 lb. coke = 0·67 lb. oil = 1·8 H.P.-hours.

Or coke at $4 per ton = oil at $6 per ton = energy at $12·25 per H.P.-year.

It would seem, therefore, that coke generally is the cheapest; but in Norway, where coke is $6 per ton and electrical energy not over $10 per H.P.-year, the electric furnace is cheaper.

Further, the cost of crucibles destroyed, labour, and deterioration of metal, may render the electric furnace cheaper in many other localities than Norway. Besides, some electric furnaces are working at efficiencies nearer 75 per cent. than 50.

On page 427 of the article the figure 0·18 per cent. is obviously a mistake for 18 per cent.

The figure of $12¼ which is given at the end of the article seems to be wrong.

1·8 H.P.-hours is equivalent to 1 lb. coke, and 1 ton of coke is consequently equivalent to 2,000 × 1·8 (365 × 24) H.P.-year = 0·41 H.P.-year, costing $4.

Therefore, 1 H.P.-year costs 4 ÷ ·41 = $9·7.

It would seem, therefore, that the deductions at the conclusion of the article are not clearly proved.

Rubber Exhibition, London, 1911.—We have received from the manager of the INTERNATIONAL RUBBER AND ALLIED TRADES EXHIBITION (75, Chancery Lane, W.C.) a copy of the prospectus for the exhibition which is to be held at the Agricultural Hall, London, N., from June 24th to July 11th next. The Exhibition, we are informed, will be both scientific and educational, and will comprise in addition to crude and manufactured rubber, machinery and appliances necessary for its production and manufacture. Countries producing rubber will be officially exhibiting through their Governments, and manufacturers from all parts of the world will be represented.

TRAMWAY and RAILWAY NOTES.

(*Continued from page* 98.)

Continental Notes.—GERMANY.—The Prussian State Railway estimates for 1911 include the sum of £1,350,000 for works in connection with the conversion of main lines to electric traction. The expenditure chiefly relates to the construction of experimental sections, particularly between Magdeburg and Bitterfeld, the southern portion of which is approaching completion between Dessau and Bitterfeld, and between Laubau and Konigszelt. It is stated that the Dessau-Bitterfeld section is installed on the single-phase system, and that brown coal or lignite is to be used as fuel in the power station, large deposits existing at Muldenstein, near Bitterfeld. The power station is being built there by the A.E.G. in conjunction with the Siemens-Schuckert Works. Steam turbo-generators are installed, and the station belongs to the contracting company, which will sell power to the railway authorities. By means of transformers the single-phase alternating current of 3,000 volts is raised to 60,000 volts in the power station, and then sent into the feeders, which supply sub-stations along the route, where the current is transformed down to 10,000 volts. At this pressure the current is supplied to the working conductors, whence it is collected by bow collectors on the locomotives and again converted by a further transformer to the working pressure of the motors. Two types of locomotives were ordered by the State railway authorities from the A.E.G., the Siemens-Schuckert Works and Brown, Boveri & Co., one being for goods trains and the other for fast passenger trains. Each is equipped with a single motor, which is for an output of from 600 to 800 H.P. in the case of the goods locomotive and 1,000 H.P. in that of the express locomotive, and the maximum speeds are put at 37 miles and 80 miles an hour respectively.

BELGIUM.—La Société Internationale d'Electricité, of Liége, jointly with M. Henri Pieper, owns the petrol-electric system recently described by us in connection with the Daimler petrol-electric 'bus. As a result of extended trials of the system that have been made on the lines between La Louvière and Manage and between Mons and Quevy, Belgium, La Société Nationale des Chemins de Fer Vicinaux, of Brussels, has lately ordered eight petrol-electric cars for the light railway between La Petite-Espinette and Waterloo, and for the tramway inside the grounds of the Exhibition at Charleroi. The new system is also being adopted in France, on the line between Saint Germain and Poissy, by the Compagnie des Chemins de Fer de Grande Banlieue.

FRANCE.—A new section of the Paris underground electric railway connecting the Place du Danube in the north-east and the outer Boulevards line is to be opened this week.

AUSTRIA.—Vienna, with 2,000,000 inhabitants, is one of the few great cities still possessing no electric railways. Exhaustive statistics have been compiled of the cost and returns and on the general circumstances of electrification in other countries, and recently the Vienna Elektrotechnische Verein was invited to give opinions on 12 questions submitted by the Traffic Commission. Summarised in its final paragraph the Verein's reply is that the improvement of the State railways in Vienna can only be fully carried out by all the subsidiary extensions being realised to their utmost extent. But the electrification of the already existing lines is a question which is absolutely unpostponable. The transformation may take a long time, but the increase of revenue which would immediately result would have a beneficial influence on later developments and operations.—*Elektro. und Masch.*

According to the *Oesterreichischer Central-Anzeiger*, a scheme has been evolved for providing the town of Zazowsko, in Galicia, with an electric tramway, to be worked with power derived from the River Dunajee. Prof. Ossowski is the author of the scheme, the cost of which is estimated at 17,000,000 kr.

Ealing.—The town clerk at the last meeting of the Council mentioned that a letter had been received from the Tramway Co., to the effect that the company was experimenting with a view to preventing the grinding noise occasioned by cars turning corners, and the company hoped the efforts would be successful. The company also hoped very shortly to overcome any cause for reasonable complaint, as the cars were now being overhauled at the tramway shops, and in the London Electric Railway shops as well, so that the work might be done thoroughly and as quickly as possible.

Glasgow.—The "two-stage" fare experiment over the entire system of the Glasgow tramways was inaugurated on Sunday, 15th inst. The principle of the innovation is that for 1½d. a person can travel two consecutive half-penny stages on one car and a similar distance on any other car. When a "two-stage" fare is asked for, the conductor gives the passenger a yellow ticket which is retained after the first car has been left and given up to the conductor of the second car, from whom a chocolate-coloured voucher for the remainder of the journey is got. The "two-stage" ticket is, therefore, not only a transfer voucher but can be used as a return ticket, if necessary. On Sunday the total number of two-stage tickets issued was 14,421, and of these 9,504 were used for the second journey. From Monday onward about 50,000 daily took advantage of the "two-stage" system, under which, if established after the present period of experiment, the general manager estimates that the Corporation will drop £76,000 per annum in revenue.

Irlam.—The Salford T.C. has informed the U.D.C. that the present time is inopportune for the extension of the electric tramways to Irlam.

London.—According to the *Pall Mall Gazette* "a leading electrical company" is making a survey of the East London Railway, with the consent of the Joint Committee, with a view to reporting as to the cost of electrification, &c. The question of D.C. or A.C. working crops up, as both the District and the Brighton companies are among the lessees.

The remodelling of the Mansion House station is nearly completed; one of the sidings has been converted into a through track, and one of the central tracks is now used as a siding.

The Ealing Broadway (District) station is to be rebuilt at an early date.

According to the *Financial News*, a Bill is being jointly promoted by the Great Western and Central London Railways, providing for an extension of the Central London line from Wood Lane to Ealing Broadway—a distance of about 4¼ miles. It is intended that all Great Western main line trains shall thus connect with the Central London. It is stated that the cost of building the line is to be borne by the Great Western. The line will be electric, and a rapid service will be provided for. The scheme will involve large extensions of Ealing Broadway Station and of the Central London Station at Wood Lane.

Malvern.—The U.D.C. has decided to offer strenuous opposition to the Bill of the Malvern Electric Traction Co.

Manchester.—A topical article on electrical progress in Lancashire, in the *Manchester Evening News*, says: "It is satisfactory to state that the Great Central, London and N.W., and Lancashire and Yorkshire Companies are now engaged in perfecting plans for electrifying some 200 miles around Manchester, affectjng 40 or 50 towns and suburbs." It is also suggested that some part of the work will be carried out in about a year. We are afraid this development must be classed with the Edison battery—always coming, never here.

Matlock.—No opposition has been forthcoming to the railless tramway scheme for Matlock.

Milnrow.—At the meeting of the D.C. on the 12th inst., it was decided that the clerk be instructed to write to the Rochdale Corporation and see when it was going to start with the construction of the tramways. The clerk said he understood that the erection of the poles and overhead equipment would be done quickly, as the Whitworth Valley section was finished.

Panama.—According to an *Electrical World* report, electric locomotives will be used for towing ships through the Panama Canal locks. The locomotives will be gear connected to the track by a middle rack rail, in order to obtain the requisite tractive effort, and the installation will be carried out by the Canal authorities.

Sheffield.—The T.C. has been recommended to erect new car-sheds at a cost of £26,000.

Stone (Kent).—The P.C. has decided to support the application for an order authorising the contruction of tramways through the parish from Dartford and Northfleet.

Taunton.—At a meeting of the T.C. last week, the Tramways Committee recommended that the tramcars, drivers and conductors in the town be licensed, the same as hackney drivers. This would give the Council greater control over them, and also the right to inspect the cars. With regard to the noise of the cars, the Committee thought the best way to deal with it would be for the borough surveyor to inspect the track, after which the Committee would take steps to have the work of remedying defects carried out. The Committee's recommendations were adopted.

Tottenham.—Negotiations are proceeding between the U.D.C. and the Metropolitan Electric Tramways, Ltd., upon various subjects, including the extension of the company's tenure of the existing tramways until 1946. The matter originated upon a suggestion that the company should construct a tramway in St. Anne's Road to connect the existing tramway in Green Lanes with that in Seven Sisters Road.

Worthing.—Convened by private circular, a numerously attended meeting of tradesmen and property owners at Worthing was held last week to discuss the proposed introduction of electric tramways and 'buses into the borough, and their effect on the future prosperity of the town; and the outcome of the deliberations, which were private, was a strongly worded resolution protesting against both the Brighton and District Tramways scheme and the railless traction 'bus scheme, and calling upon the T.C. to oppose both Bills by every means in its power. It was also decided to prepare a memorial setting forth the objections of the petitioners to the schemes, for presentation to the T.C. A special meeting of the T.C. in connection with the same matter was held on Wednesday evening, and as the result of a long discussion in private, a resolution to oppose the Tramways Bill was carried practically without opposition. The Council had previously decided to oppose the railless traction proposals, so that this decision means that both schemes are to be strenuously opposed by the Corporation.

TELEGRAPH and TELEPHONE NOTES.

Australia.—The Postmaster-General of New South Wales reports that applications are being received for new telephone connections at the rate of upwards of 5,000 per annum. In addition to these, the present subscribers are having their services largely increased. Additional trunk lines to the number of 153 have been provided in the metropolitan district. Five new junction lines have been provided between Newcastle and Stockton, including a submarine cable. The work of undergrounding in the city is being pushed on. Nineteen exchanges have been equipped with new plant. With regard to the telegraphic work, 1,392 miles of line wires and 70 miles of re-poling have been put up, or are now in hand. In addition, repairs are being carried out at a cost of £38,000. Telephone trunk lines totalling 1,276 miles of new line wire have been erected, or will be completed shortly.

The contract for the erection of the wireless telegraph stations at Pennant Hills and at Fremantle by the Australian Wireless, Ltd., has been signed. The work on the part of the contractors is already well advanced, and it is expected that the Pennant Hills station will be completed in four or five months, and the Fremantle station two months later

Austria.—The Vienna branch of the Hanover Telephone Works Co. (formerly Berliner) is in negotiation for the reconstruction of the Vienna telephone network, and for the supply to various military authorities of wireless telegraph apparatus on the Poulsen system as acquired by the company. With the co-operation of the Vienna Bank Verein, the company's Hungarian factory is to be converted into a limited company with a capital of 1,500,000 crowns and headquarters in Budapest. The question of an amalgamation of the Hanover Co. with the Lorenz Co. is reported to be at the stage of initial negotiation.

China.—An American Consular report draws attention to the enormous possibilities of the telephone market in North China. The Chinese have come to realise the utility of electricity, and are ready to consider its application wherever possible.

Ecuador.—The Guayaquil Telephone Co. is about to convert its system to common-battery working at a cost of £25,000.

The German-South American Cable.—The cable steamer *Stephan*, which belongs to the North German Sea Cable Works, of Nordenham, has now left Bremen for the purpose of laying the third and final section between Monrovia and Pernambuco of the German-Brazilian cable. It is stated that the service with the cable will probably be commenced at the end of March.

Hull.—At a meeting of the Corporation Telephone Committee on Monday, the manager, Mr. Holme, presented his estimates for the next financial year. Expenditure is put down at £11,400, and revenue at £12,600, the balance being £1,200. The expenditure includes £1,260 paid in royalties to the Government.

Loaded Cables.—The *Electrical World* announces the issue of a patent to Dr. J. H. Kuntz, New Jersey, covering a method of counteracting the capacity of a cable by means of distributed inductance. The conductor is disposed helically about a core, which may or may not be of iron, according to the amount of inductance required. It is claimed that the amount of inductance can be closely predetermined by calculation. The application was originally filed on March 29th, 1901.

Roumania.—After keen competition between European and American firms, the Government of Roumania has placed with the Siemens & Halske Co., of Berlin, the contract for the establishment of a new telephone exchange in Bucharest for 14,000 subscribers, although the first instalment will only be for 6,000 connections. The exchange to be replaced by the new one was carried out on an American system.

Telephone Interruption.—The telephone service between Dover and London was cut off for several hours on Thursday last week, owing to the gale. A large tree was uprooted and blown down at Barfrestone, and brought down 18 telephone wires.

The Telephone Transfer.—It is reported that the British Government has retained Mr. Dugald Jackson, the President of the American I.E.E., to advise the Postmaster-General regarding the value of the property of the National Telephone Co. Mr. Jackson, says the *Times*, is a recognised authority with regard to telephones. He advised the Chicago City Corporation and the Massachusetts Highway Authority in their recent negotiations with the local telephone companies, and his reports are regarded in the United States as being in the nature of standard works upon telephone rates.

Uruguay.—An American Consul reports that the two telephone companies in Monte Video have 17,694 miles of wire in use, with 8,150 telephones. In no long time the Government will take up the telephone service.

Wireless Telegraphy.—Wireless telegraphy, says the *Times*, according to a recent order of the U.S.A. War Department, is in future to be the regular means of communication between the military posts of the further Middle West. Wireless stations are already in operation at Fort Leavenworth and Fort Riley. They will shortly be installed at Denver, Cheyenne, and other western posts.

On Monday the Cunard steamer *Carmania*, equipped with the 1½-KW. Marconi standard installation, succeeded in communicating with Crookhaven, in the south of Ireland, when 210 miles east of Gibraltar. The distance thus covered was over 1,000 miles.

It is notified by the Indian Telegraph Department that the wireless system between Aden and Berbera is open for paid traffic.—*Indian Engineering*.

An important combination has been effected between the German Telefunken Co. and Marconi's Belgian Co., so far as relates to the German mercantile marine; a new company will be formed for the purpose of equipping the German vessels with wireless installations on either the Marconi or the Telefunken system, as may be preferred by the owners.

CONTRACTS OPEN and CLOSED.

OPEN.

Annfield Plain (co. Durham).—January 23rd. Electric installation at the Electric Theatre, for R. J. W. Bloom; L. H. Armour, 16, West Street, Gateshead.

Australia.—February 1st. Testing equipment, for the P.M.G.'s Department in New South Wales. See "Official Notices" December 9th.

February 7th.—250 indicators, for the P.M.G.'s Department in Victoria. See "Official Notices" December 16th.

March 7th.—Eleven sections of a branching multiple magneto lamp-signalling switchboard, for the P.M.G.'s Department in Victoria. See "Official Notices" December 16th.

March 14th.—Installation of wireless telegraphy at Thursday Island and Papua, for the P.M.G. of Australia. See "Official Notices" December 23rd.

April 18th.—One common-battery switchboard, for the P.M.G.'s Department in Western Australia. See "Official Notices" Dec. 23rd.

February 21st.—29 miles of telegraph cable, for P.M.G.'s Department, Victoria. See "Official Notices" January 6th.

February 28th.—One petrol-driven portable winch, for P.M.G.'s Department, Victoria. See "Official Notices" January 6th.

February 28th.—Motor-generator and accumulators, for the P.M.G.'s Department in Victoria. See "Official Notices" Jan. 13th

March 7th.—10,000 telephone protectors, for the P.M.G.'s Department in Victoria. See "Official Notices" January 13th.

March 8th. Measuring instruments for the P.M.G.'s Department in Queensland. See "Official Notices" to-day.

Barnes.—February 13th. Straight-tube water-tube boiler fitted for machine stoking, 600-750-KW. steam dynamo, surface condenser, motor-driven air and circulating pumps, river work and piping, for the U.D.C. See "Official Notices" Jan. 13th.

Birkenhead.—January 30th. Stores for a year from March 31st, for the Corporation generating stations; Wm. Wild, borough electrical engineer, Craven Street station.

Birmingham.—January 30th. Stores for the Corporation Tramways Department. See "Official Notices" Dec 30th.

Bacup.—February 5th. High and low-tension cables and ducts, transformers and meters, for the Corporation. See "Official Notices" January 13th.

Cape Town.—March 1st. Tenders are invited for the installation of a system of ventilation, heating and cooling in the new Law Courts. See this column in our issue of December 30th.

Cheltenham.—January 28th. Electric light fittings, for a year, for the T.C. J. S. Pickering, borough engineer, Municipal Offices.

Croydon.—January 26th. Five single-truck double-deck cars, for the Corporation tramways. See "Official Notices" January 13th.

Halifax.—February 6th. Stores and materials for the Corporation Tramways and Electricity Departments. See "Official Notices" to-day.

Huddersfield.—February 4th. Steel Lancashire boiler, 7 ft. diameter, 29 ft. long; Edward A. Harman, gas engineer, Huddersfield.

India.—February 6th. Combined H.T. and L.T. switchboards for new sub-stations, and switchboards for the Cossipore station, for the Calcutta Electric Supply Co., Ltd. See "Official Notices" January 13th.

Ipswich.—February 9th. Continuous-current high-pressure steam turbo-generator (600 or 750 KW.), with surface-condensing plant, for the Corporation. See "Official Notices" to-day.

Leeds.—February 16th and 21st. (*a*) 1,500 alternating-current watt-hour-meters; (*b*) coal and stores, for the City Electric Lighting Department. See "Official Notices" to-day

Leek.—February 9th. Diesel engine and D.C. dynamo, for the U.D.C. See "Official Notices" to-day.

London.—ISLINGTON.—February 23rd. Electrical and engineers' stores, for the B.C. See "Official Notices" January 13th. HAMMERSMITH. January 25th. 3,000-KW. steam turbine-generating set, with condenser, and E.H.T. feeder mains, and L.T. distributing mains, for the B.C. See "Official Notices" to-day.

Plymouth.—January 25th. Stores for a year, for the Corporation Electricity and Street Lighting Departments. See "Official Notices" January 6th.

Portuguese West Africa.—March 25th. The municipal authorities of San Thomé, Portuguese West Africa, are inviting tenders for the concession for the establishment of a central generating station for the supply of electrical energy for lighting and power purposes in the town.

Rawtenstall.—February 1st. Extension to the H.T. switchboard at the Cloughfold Electricity Works, for the Corporation. See "Official Notices" to-day.

Salford.—February 13th. Stores for a year, for the Corporation Electricity Department. See "Official Notices" to-day.

Shanghai.—January 26th. 6,600-volt three-core cable, stoneware troughing, bitumen, &c., for the Municipal Council. See "Official Notices" January 13th.

Sheffield.—January 21st. Stores, for the Corporation Tramways Department. See "Official Notices" January 6th.

Spain.—The municipal authorities of Vezdemarban (Zamora province) have just invited tenders for the concession for the public and private electric lighting of the town during a period of 15 years. Similar tenders have also been invited by the municipal authorities of Galaroza (province of Huelva), the duration of the concession in this case being only six years.

Sweden.—March 31st. The Wasserfalldirektion in Stockholm is inviting tenders for the supply of four turbines of 12,500 H.P. capacity.

Turkey.—March 14th and 15th. The Ministry of Public Works is prepared to receive tenders for the following works:—(1) Construction of a generating station in the Vilayet of Constantinople; (2) construction of tramways and a generating station in the Sandjak of Adrianople. See this column in our issue of January 6th.

Turton.—February 20th. Bare copper overhead mains, poles, &c., for electric lighting in Bromley Cross area and Bradshaw Road, &c., for the U.D.C. See "Official Notices" to-day.

Wakefield.—February 14th. 800-KW. steam alternator, for the Corporation Electricity Department, See "Official Notices" to-day.

West Ham.—January 31st. Supplies, &c., for the Corporation Electricity Department. See "Official Notices" to-day.

CLOSED.

Belgium.—No fewer than 10 concerns—six German and one each British (the British Insulated and Helsby Cables Ltd.), French, Belgian and Austrian—submitted tenders to the Belgian State Railway authorities in Brussels, for the supply and laying of a number of telephone cables in the Liége district, the lowest being that of Messrs. Felten & Guilleaume, of Mulheim-am-Rhine.

Bury (Lancs.).—The T.C. has accepted the tender of Messrs. Foster Bros., Ltd., of Wednesbury, for steam pipes, &c., for the power station.

East Ham.—The T.C. has accepted the following tenders for the supply of generating and condensing plant for the electricity undertaking:—

British Westinghouse Electrical and Manufacturing Co., Ltd.—1,000-KW. Browett, Lindley & Co. engine and Westinghouse generator, £5,540.
Dean & Beale, Ltd.—Evaporative condensing plant, £5,490.
W. Wood & Co.—Supply of "figure 8" trolley wire, 7¾d. per lb.

Edmonton.—The B. of G. has accepted the tender of Messrs. May & Hawes for lighting the grounds of the new infirmary by electricity, at £245.

London.—The Metropolitan Asylums Board has received the following tenders for the supply of a 30-cwt. electric vehicle for the Children's Infirmary:—

Cedes Electric Traction, Ltd.	(accepted)	£499 10
Henry Simonis & Co.		630 0

Lowestoft.—The T.C. has accepted the tender of the British Westinghouse Co., Ltd., for the supply of pinion wheels for the tramways department; also the following tenders for annual supplies for the electricity department:—

Callender's Cable and Construction Co.—Service boxes, 5s. 9d. each.
Geipel & Lange.—Carbons at schedule prices.
W. Lucy & Co., Ltd.—House cut-outs, 2s. 10d. each.
Siemens Bros., Ltd.—Meters at schedule prices.
British Westinghouse Co., Ltd.—Motors at schedule prices.
Edison & Swan, Ltd.—Incandescent lamps at schedule prices.
Electrical Co., Ltd.—Metallic-filament lamps at schedule prices.
Drake & Gorham, Ltd.—Tantalum lamps, 1s. 4½d. each.
Welsbach Co.—Street lamp globes, 2s. 10d. each.

South Africa.—The *British and South African Export Gazette* states that a Swedish firm is now executing the large order for 50,000 telephone instruments for which tenders were recently invited by the authorities at Cape Town.

Stalybridge.—The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board, for their generating station at Stalybridge, have ordered a further two "Bennis" stokers and self-cleaning compressed-air furnaces from Messrs. Ed. Bennis and Co., Ltd.

Sunderland.—The T.C. on 11th inst. accepted tenders as follows:—

Rickard, Ltd.—V.I.R. service cable.
Farrow & Co.—Pavement boxes and wrought-iron tubing and bends.

Swinton and Pendlebury.—The U.D.C. has accepted the tender of Messrs. Callender's Cable and Construction Co., at £218, for electric mains extension.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, January 20th. At 8 p.m. At the Institution House, Storey's Gate, S.W. Paper on "Modern Electrical Dock Equipment, with Special Reference to Electrically-operated Coal-Hoists," by Messrs. W. Dixon and G. H. Baxter.

Royal Institution.—Friday, January 20th. At 9 p.m. Discourse on "Chemical and Physical Changes at Low Temperatures," by Prof. Sir J. Dewar.

Institution of Electrical Engineers (Manchester Students' Section).—Tuesday, January 24th. At 7.30 p.m. At the Municipal School of Technology, Manchester. Paper on "Switchboard Measuring Instruments," by Mr. H. T. Warner.

Institution of Electrical Engineers.—Thursday, January 26th. At 8 p.m. At the Institution Building, Embankment, W.C. Papers on "Modern Long-Distance Transmission of Electrical Energy," by Mr. W. T. Taylor; and "Extra-High-Pressure Transmission Lines," by Mr. R. Borlase Matthews.

Leeds Association of Engineers.—Thursday, January 26th. Paper on "Modern Methods of Boiler Setting," by Mr. M. L. Sykes.

Royal Institution.—Friday, January 27th. At 9 p.m. Discourse on "Radio-Activity as a Kinetic Theory of a Fourth State of Matter," by Prof. W. H. Bragg.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

THE following orders are issued:—

Commanding Officer—COL. H. M. LEAF.

Monday, January 23rd.—"A" Company. Technical drill, 7 to 10 p.m.
Tuesday, January 24th.—"B" Company. Technical drill, 7 to 10 p.m.
Thursday, January 26th.—"C" Company. Technical drill, 7 to 10 p.m.
Friday, January 27th.—"D" Company. Technical drill, 7 to 10 p.m.
Saturday, January 28th.—"D" Company's Annual Dinner, at the "Cabin Restaurant," Caxton House, Westminster, S.W., at 7.30 p.m.

(Signed) P. H. CAMPBELL, Capt. R.E., Adjutant.

Who is Mr. Vachell?—Of Vachell, the novelist, have we heard, but what Vachell is this giving evidence on Wednesday in the Marconi case? The *Times* describes him: "Mr. William Henry Vachell, vice-president of the Institution of Electrical Engineers."

Western Canada.—AN APPEAL TO BRITISH MANUFACTURERS.—At a special meeting of the London Chamber of Commerce on Tuesday, Mr. J. S. Dennis, of the Canadian Pacific Railway, delivered an interesting address, in the course of which he urged British manufacturers and British settlers to go to Western Canada. In regard to the trade prospects, he urged how important it was that our manufacturers should go themselves, and not be content with sending juniors or commercial travellers. He appealed to them, reports the *Times*, to strengthen trade relations by supplying just the style of goods required. They could then more than compete with the American manufacturers; and Western Canadians took an enormous quantity of manufactures per head. Already British manufacturers found their way to British Columbia by the Suez Canal; and when the Panama Canal was opened, if its tolls were equitable, such goods should go by that route for the whole of the West as far inland as the middle of Saskatchewan.

Statue to Lord Kelvin.—The Committee in charge of arrangements for the erection of a statue to the late Lord Kelvin, who was the first president of the Glasgow Local Section of the I.E.E., have acknowledged with thanks the local section's contribution to the memorial fund, and have expressed their acquiescence in the suggestion of the section that the statue should be placed in the West End Park, and as contiguous as possible to the University in which, as a professor, the deceased achieved many of his triumphs.

NOTES.

Copper.—Mid-monthly returns, as shown by Messrs. Merton's circular, give visible supplies at 83,238 tons, a decrease of only 559 tons since the end of December. The average withdrawals for the past ten months have been at the rate of 2,965 tons per month. The net withdrawal from English ports was 599 tons, Havre only losing 10 tons, and the quantity afloat from Chile and Australia being 50 tons more than at the end of December. Supplies from North America to England are high, being 7,128 tons, against an average of 7,074 for a whole month. To other European ports, however, they are low. Supplies from Spain are low. Chile shipments are up to average, and Australian, at 2,200, against an average of 3,493, fairly high. Total deliveries, however, are below average. Stocks at Rotterdam show 700 tons better than for December 31st; those at Hamburg are estimated to be the same. American stocks for the end of December were 54,478 tons, a decrease for the month of 3,732 tons against 4,340 tons per month for the last five months.

Institution and Lecture Notes.—Glasgow and West of Scotland Association of Foremen Engineers and Draughtsmen.—At a meeting, on 14th inst., a paper was read by Mr. Quinton Henderson, on "The Application of Electricity to Crane Work." The lecturer made a comparison between the old types of rope and steam-driven cranes and modern electrically-driven cranes, and demonstrated the efficiency and economy of the latter. He pointed out the losses consequent upon plant being run under the old system when no work was being done, and argued that with the electrically-driven crane energy was only absorbed when practical work was being done, while speeds were increased, which meant a considerable item in the cost of production. The electrically-driven crane was particularly adaptable in cities where Corporation electric mains were already installed, as tappings could be got at any point for various purposes, particularly for building operations. In dealing with the control of electric cranes the lecturer advocated the liquid against the tramway type of controller.

Midland Institute.—The City of Birmingham Electric Supply Department arranged some exhibits at the Midland Institute conversazione, which was held in the Town Hall and Midland Institute from January 10th to 14th. This function is one of the most important social events in the city, and was attended by 5,474 visitors. The principal item was the demonstration of electrical domestic appliances, and included two cookery lectures each evening. The demonstrations were attended by interested audiences, who were astonished at the results obtained, and the apparatus used came in for most favourable criticism. In the scientific section a demonstration of electric welding was given. This demonstration appealed very strongly to representatives of the metal trades, and it is certain that the Electric Supply Department will derive much benefit from its enterprise. The Midland Institute had arranged a most attractive programme, and an exhibition of scientific apparatus of wide interest, including a variety of exhibits provided by the Birmingham University.

Institution of Electrical Engineers (Yorkshire Local Section).—On Wednesday last week Dr. Henry Stroud gave an interesting address to the members of the Yorkshire Section at Leeds University on "Radio-Telegraphy." Increased interest was occasioned by apparatus which had been fitted up in the room for the purpose of demonstrations, which were highly appreciated by the crowded attendance. Dr. Stroud described very fully the apparatus in use in the Physical Department of the Armstrong College, which is used for experimental purposes. A description of the station appeared in our pages in 1909, when Dr. Stroud gave a similar address before the Newcastle Local Section. A general idea was given of the principles and modern developments of radio-telegraphy, with special reference to the Armstrong station and its objects.

Birmingham Electric Club.—On Saturday last Mr. F. W. Foster delivered his presidential address. He said that very few of the best employés in electrical works took advantage of the educational facilities offered in the city. The education of the men rested with the employers. If they wanted to avoid labour troubles, they might do so to a large extent by increasing their men's interest in their work. Discussing the prospects of the electrical profession, Mr. Foster took an optimistic view, and pointed to many local undertakings which would benefit the profession.

Association of Mining Electrical Engineers (East of Scotland Branch).—A meeting of the branch was held in Dunfermline on Friday. Mr. H. Gordon Fraser, Leven, chief electrical engineer, Fife Coal Co., presided over a good attendance of members. A proposed scheme of examination for certificates for electrical engineers was discussed, and a paper by Mr. E. Kilburn Scott on "Electricity in New South Wales Collieries," was read and discussed.

Tramways and Light Railways Association.—Commencing with the January number, the "Official Circular" now becomes the *Journal* of the Tramways and Light Railways Association. The annual dinner and smoking concert will be held during February, if possible on Friday, the 17th.

On Tuesday Dr. J. Hall Edwards gave a lecture on the Röntgen rays at the Bishopsgate Institute, E.C.

Fatalities.—A young Carlisle electrician, named John James Armstrong, met his death under extraordinary circumstances on Monday afternoon. He was engaged in soldering with a blow lamp in a cage suspended to the beam of a huge crane at Cowans Sheldon's works, when the canvas covering caught fire. Soon the unfortunate young man was surrounded by flames. He was about 50 ft. from the ground, and had no alternative but to jump out of the burning cage. He fell heavily on the hard ground, breaking a leg and an arm, and receiving serious internal injuries. He was taken to the Cumberland Infirmary, where he died the same night. He was only 18 years of age.

Reynold Munro, 26, an Edinburgh electrician, succumbed on 11th inst., to the injuries received under circumstances recorded on page 48 of our last issue.

Appointment Vacant.—Assistant telegraph mechanician for the Lagos Government Railway, Southern Nigeria (£250). See our advertisement pages in this issue.

Wood Separators for Storage Cells.—An abstract of a patent by Mr. Pascal Marino is given in *La Revue Electrique*, relating to a process for preparing wood separators for use in accumulators. The boards are first subjected to the action of steam under pressure at a temperature of 120° C., for a period of 15 minutes. The steam drives out the air and other gases and extracts capable of fermentation, as well as soluble distillates, such as acetic acid. Next, in order to remove the vasculose which coats the cell walls, it is oxidised by the action of ozone or water charged with oxygen; for this purpose the separators, saturated with water, are exposed to a current of ozonised air, or are immersed in water impregnated with oxygen. After three hours of this treatment the boards are exposed to the air, when resinous acids are formed, and after four hours they are again steamed for 10 minutes at 110° C. Subsequent washing with cold ammoniacal water dissolves the resinous acids. Finally, the separators are rinsed with water and dried by compressed air. They are perforated with very fine holes (36 to the sq. cm.); glass wool is interposed between each separator and the adjacent positive plate.

Oldham Tramway Manager's Appointment.—The Tramways Committee received 93 applications for this appointment, and six have been selected for interview.

Ormskirk Railway Accident.—The report of Lieut.-Col. Druitt on the double collision at Ormskirk on November 25th shows that the accident was due to precisely the same cause as the disaster at Hawes Junction; the signalman forgot that he had a light engine standing on the main line. As we pointed out in the Hawes Junction case, this accident, and all such accidents, could have been avoided by the use of an electric track signalling system.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Mr. J. H. Wilkinson, A.I.E.E., of Shipley (Yorks.), has been appointed electrical and mechanical engineer for the town of Windsorton, near Kimberley, South Africa, and he left England at the end of last week to take up his new appointment. For three years Mr. Wilkinson was chief assistant engineer to the Hebden Bridge District Council (Yorks.), after which for a similar term, he was employed as electrical engineer to the Campbell Gas Engine Co. at Halifax. At a smoking concert held at the Saltaire Cycling Club house on Wednesday evening last, Mr. Wilkinson was wished *bon voyage*, and presented by the members of the club with a gold medal.

Mr. A. W. Blake, electrical engineer, of Swansea, has been installed Worshipful Master of the Loyal Monmouth Lodge of Freemasons.

Mr. H. P. Young has resigned his position with the West Bromwich Corporation, having secured the position of consumers and mains (junior) assistant to the Finchley U.D.C.

A recommendation from the Electricity Committee of the Carlisle T.C. to increase the salary of the electrical engineer (Mr. Allen) by £50 a year and yearly increments of £20 up to £450, has been deferred until the March meeting of the Corporation, in accordance with Standing Orders.

Mr. P. S. Fox, sales engineer, Electricity Works, Worcester, has been appointed canvasser to the Hampstead undertaking, at a salary of £200 per annum. There were 149 candidates.

General.—Mr. David Wells, assistant telegraph superintendent, North British Railway, has been appointed telegraph superintendent, in succession to Mr. A. F. Clement, who retired on 17th inst. Mr. Clement is an old Electric and International Telegraph Co.'s man, having commenced his telegraph career with that company in their Edinburgh office "E. H." in 1861. In 1864 his services were transferred from the Electric and International Telegraph Co. to the Scottish North-Eastern Railway Co. at Aberdeen, and when this company was absorbed by the Caledonian Railway Co. he remained in their service until 1867. During his service at Aberdeen he was under the control of the late Mr. Edward Gilbert, superintendent, and latterly became his assistant. Mr. Gilbert was appointed telegraph engineer and superintendent to the North British Railway Co. in 1867, and shortly afterwards he appointed Mr. Clement as his chief assistant. In 1874, on Mr. Gilbert's resignation to fill an important appointment in Japan, Mr. Clement succeeded him as telegraph engineer and superintendent of the North British Railway Co. Mr.

Clement's service with the North British Railway Co., therefore, extends to nearly 44 years, during 36½ of which he has filled the position of engineer and superintendent. Mr. Clement can number amongst his contemporaries many well-known "Old Electric" men, such as Mr. E. Tansley, Mr. James Gibson, Mr. David Lessells, Mr. A. W. Gray, Mr William Wood, Mr. Edward Campbell, &c. During the period of his control, the telegraph system has increased enormously, and particularly within the last 15 years, owing to the introduction of the telephone, the electrical interlocking of signals, and the many devices and inventions which a railway telegraph engineer has to provide for in these days. The block telegraph has been provided over the whole system in Mr. Clement's time, and the seriousness with which it was taken in the early days by railway telegraph engineers only calls forth a smile in these days, when electrical safety contrivances are so complex and difficult even for highly trained men. The advance, however, has been step by step, and Mr. Clement has been one of those who proved himself equal to deal with new requirements as they arose. Mr. Clement will be remembered with affection by a very wide circle of friends in the telegraph and railway world generally, both in Scotland and England. He carries with him sincere wishes for a long and happy period of retirement.

MR. MARTIN F. ROBERTS, M.Inst.C.E., M.I.E.E., F.C.S., late assistant engineer-in-chief to the General Post Office, whose retirement from the service was announced in our pages at the time, has opened an office at 137, Victoria Street, Westminster, S.W. (telephone "121, Victoria") where he will continue to act professionally as a civil engineer. Mr. Martin Roberts has recently accepted a seat on the board of Messrs. W. T. Henley's Telegraph Works Co., Ltd.

On the 11th inst. DR. THORNTON, Professor of Electricity at Newcastle University, descended the Pretoria Pit, Chequerbent, near Bolton, the scene of the appalling disaster on December 21st, and made an inspection of the workings on behalf of the Miners' Federation.

MR. R. J. BROWNE, M.I.E.E., Electrical Inspector to the Governments of Bengal and E.B. and Assam, is at present in England on leave.

The annual dinner of the Post Office Engineering Department (North-Eastern district) was held on the night of Saturday, January 7th, in the Griffin Hotel, Leeds, when special honour was paid to MR. G. M. CARR, the superintending engineer, who is retiring from the service. The chair was occupied by Mr. A. Longden, the acting chief of the district, and over a hundred members of the staff were present, including Mr E. Catley, superintending engineer of the North metropolitan district, and representatives from Sheffield, Lincoln, Middlesbrough, Hull, Halifax, Goole and Harrogate. Mr. E. Catley gave "Our Guest," and expressed the regret that all felt at Mr. Carr's retirement. The toast was supported by Mr. J. D. Taylor, Mr. S. Pickering and Mr. E. H. Farrand. Mr. Carr acknowledged the compliment. His connection with telegraphy has extended over 50 years. He commenced his services with the late Electric and International Telegraph Co., but was associated more particularly with the United Kingdom Telegraph Co., the pioneers of cheap telegraphy. In this latter service Mr. Carr had greater opportunities for originality, and gained a valuable experience. On the transfer of the telegraphs to the State in 1870, Mr. Carr took a prominent part in the great pressure of work due to the building of new lines consequent upon the establishment of the uniform shilling rate. He recalled assisting in one of the first demonstrations of the telephone made by the late Alexander Graham Bell in England in 1878, at Newcastle-on-Tyne, and opening the first telephone exchange in Sunderland in 1881. He congratulated the present members of the staff on the greatly improved conditions under which their work was carried on, and urged all the members to fully appreciate their opportunities in the part they were playing in a great department, which, notwithstanding its critics, produced results of unrivalled excellence, and was an example to the world.

The *Standard* of yesterday states that the name of MR. C. A. PARSONS, of turbine fame, is most favoured by the Unionist members of the Cambridge University Senate, as candidate for the vacant seat caused by the death of Mr. S. H. Butcher.

Obituary.—MR. J. W. PRICE.—The death occurred at Pontypridd on January 10th, of Mr. Joseph Wm. Price, local manager for the National Telephone Co., Ltd. He was 38 years of age.

We regret to record that SIR FRANCIS GALTON, F.R.S., a scientist of world repute, passed away on Tuesday at Hindhead, in his 89th year. For many years Sir Francis was a constant and active member of the British Association; he was one of its honorary secretaries for five years.

CITY NOTES.

Chatham and District Light Railways Co.

THE directors in their report for the half-year ended December 31st, 1910, give the result of the half-year's working as follows:—Revenue £24,221, expenses £13,007, leaving £11,214, less rent of Rochester Corporation lines £1,872, and interest on debentures £1,234, plus balance brought forward from June 30th, 1910, £2,909, leaving a balance of £10,198. Of this amount £4,500 has been transferred to reserve for depreciation, and it is recommended that the balance be disposed of as follows:—£2,940 to dividend at the rate of 5 per cent. per annum on the preference shares, £2,120 to dividend at the rate of 4 per cent. per annum on the ordinary shares, £638 being carried to revenue new account. The traffic receipts show an increase of £654 over those for the corresponding half-year of 1909. There is a small increase of £27 in the expenses.

COMPARATIVE TABLE.

Half-year ended	Miles open.	Passengers carried.	Traffic receipts.	Average fare.	Car-mileage.	No. of cars.
June 30, 1909 ..	14·98	4,038,327	£19,787	1·18	561,758	45
Dec. 31, 1909 ..	14·98	4,712,205	£23,045	1·17	582,637	45
June 30, 1910 ..	14·98	4,347,656	£21,029	1·16	556,211	45
Dec. 31, 1910 ..	14·98	4,869,431	£23,699	1·17	586,902	45

Direct United States Cable Co., Ltd.

THE directors' report for the half-year ended December 31st, 1910, states that the revenue, after deducting out-payments, amounted to £61,110, as compared with £60,338 for the corresponding period of 1909, an increase of £772. The working and other expenses, including income-tax, but exclusive of cost of cable maintenance, were £25,833, leaving a balance of £35,277 as the net profit, making with £4,783 brought forward from the previous half-year, a total of £40,061. For the corresponding period of 1909, the working expenses and other payments amounted to £25,290. Interim dividends of 4s. per share, for the quarter ended September 30th, 1910 (paid October 27th, 1910), and of 4s. together with a bonus of 2s. per share for the quarter ended December 31st, 1910, payable January 31st, 1911, together amounting to £30,355 (both free of income-tax) have been declared, and after setting aside £5,000 to the reserve fund account, the balance of £4,706 on the revenue account has been carried forward. The reserve fund account has been debited with £6,748 for the cost of cable maintenance; £3,279, for expenditure upon property at Ballinskelligs; and £26,028, cost of diversion of cable to Harbor Grace, Newfoundland; and after being credited with interest on the investments, profit on sale of securities, and amount set aside from revenue, the balance now amounts to £513,518.

Metropolitan Railway Co.—The directors recommend a dividend at the rate of 1½ per cent. per annum on the consolidated stock for the past half-year, with the transfer of £10,000 to electrical renewal account, carrying forward £9,500. This compares with 1 per cent. per annum paid a year ago, when £5,000 was transferred to electrical renewal account, and £5,926 carried forward. The distribution on the surplus land stock is at the rate of 2¾ per cent. per annum for the past half-year, carrying forward £2,000, as against £1,785.

British Columbia Electric Railway Co., Ltd.—The directors have declared a dividend at the rate of 5 per cent. per annum on the 5 per cent. non-cumulative preferred ordinary stock for the half-year to December 31st, plus an extra dividend at the rate of 1 per cent. per annum for the same period.

Brazilian Electricity Co.—The Brasilianische Elektrizitäts Gesellschaft, of Berlin, which is said to act as owner of a telephone system in Rio de Janeiro of the book value of £275,000 and which was formed with a share capital of £250,000, incurred expenses of £272 in Berlin in 1909-10, as compared with £415 in the preceding year. The former amount has been paid by the Rio de Janeiro Telephone Co. so as to equalise the balance sheet. It appears that the German company has not paid any dividend for four years. The shares are, however, no longer in German ownership as they were sold to a Canadian syndicate in 1905, together with the preference shares.

Central London Railway Co.—The dividend for the past half-year is at the rate of 3 per cent. per annum. The deferred get 2 per cent. for the year, the same as for 1909. The carry-forward is £33,645. The amount placed to reserve is increased from £2,040 to £10,000.

Stock Exchange Notices.—The Committee have ordered the undermentioned securities to be quoted in the Official List:—

Commercial Cable Co.—£13,133 additional sterling 500-year 4 per cent. debenture stock.

Cordoba Light, Power and Traction Co., Ltd.—472,447 ordinary shares of £1 each, fully-paid (Nos. 1 to 472,447); and 500,000 5 per cent. debenture stock.

Electric Light and Power Co. of Cochabamba.—£300,000 6 per cent. Government guaranteed loan (bonds, Nos. 1 to 2,800 of £100; and 2,801 to 3,800 of £20 each).

Prospectus.—*Sao Paulo Tramway, Light and Power Co., Ltd.*—The list is to close to-day in an issue of £300,000 5 per cent. perpetual consolidated debenture stock, which is being offered at 100 per cent. The money is required for the general purposes of the company, to meet capital expenditure occasioned by increasing business in every department.

Venezuela.—The Compania Electricidad de Valencia, of Valencia, has declared a dividend of 12 per cent. for the past financial year.

Japan.—The Tokyo Electric Light Co., of Tokio, is declaring a dividend of 12 per cent. for the last financial year.

Montreal Light, Heat and Power Co.—A dividend of 2 per cent. is announced for the quarter ending 31st inst.

Continental.—GERMANY.—A meeting of the shareholders in the Deutsch-Ueberseeische Electricitäts Gesellschaft is about to be held in Berlin, to sanction an increase in the capital of the concern from £4,500,000 to £5,000,000.

MARKET QUOTATIONS.

Wednesday, January 18th.

CHEMICALS, &c.	Latest Price.	Fortnight's Inc. or Dec.
, Hydrochloric .. .. per cwt.	5/-	..
a „ Nitric .. .. „	22/-	..
a „ Oxalic .. .. „	28/-	..
a „ Sulphuric .. .. .. „	5/6	..
a Ammoniac, Sal .. .. .. „	42/-	..
a Ammonia, Muriate (crystal) .. per ton	£29	..
a „ „ .. .. .. „	£30	..
a Bleaching powder .. .. .. „	£5 10	..
a Bisulphide of Carbon .. .. „	£18	..
a Borax .. .. „	£16	..
a Ferro-Silicon (50 %) .. .. „	£9 10	..
a Copper Sulphate .. .. .. „	£21	£3 inc.
a Lead, Nitrate .. .. .. „	£25	..
a „ White Sugar .. .. „	£22 15	..
a „ Peroxide .. .. .. „	£33	..
a Methylated Spirit .. .. per gal.	2/6	..
a Potassium, Bichromate, in casks per lb.	8¼d.	..
a Potash, Caustic (75/80 %) .. per ton	£30	..
a „ Chlorate .. .. per lb.	3½d.	..
a „ Perchlorate .. .. „	4½d.	..
a Potassium, Cyanide .. .. „	7d.	..
a Shellac .. .. per cwt.	80/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	..
a Sulphur, Sublimed Flowers .. „	£6 10	..
a „ Recovered .. .. „	£5 10	..
a „ Lump .. .. .. „	£5	..
a Soda, Caustic (white 70 %) .. „	£11	..
a „ Chlorate .. .. .. per lb.	3½d.	..
a „ Crystals .. .. .. per ton	£3 5	..
a Sodium Bichromate, casks .. per lb.	3d.	..
a „ Cyanide (basis 100 %) .. „	7d.	..
METALS, &c.		
b Aluminium Ingots, in ton lots .. per ton	£80	..
b „ Wire, in ton lots .. „	£112	..
b „ Sheet, in ton lots .. „	£120	..
p Babbitt's metal ingots .. .. „	£38 to £145	..
c Brass (rolled metal 2" to 12" basis) per lb.	6½d.	..
c „ Tube (brazed) .. .. „	8¼d.	..
c „ „ (solid drawn) .. „	7d.	..
c „ Wire, basis .. .. .. „	6¼d.	..
c Copper Tubes (brazed) .. .. „	9d.	..
c „ „ (solid drawn .. „	8¾d.	..
g „ Bars (best selected) .. per ton	£71	..
g „ Sheet .. .. .. „	£71	..
g „ Rod .. .. „	£71	..
c „ (Electrolytic) Bars .. „	£58 10	10/- dec.
c „ „ Sheets .. „	£74 10	10/- dec.
c „ „ Rod .. „	£62 5	10/- dec.
c „ „ H.C. Wire per lb.	7 1/16d.	1/16d. dec.
f Ebonite Rod .. .. .. „	6/-	..
f „ Sheet .. .. .. „	5/6	..
m German Silver Wire .. .. „	1/11	..
h Gutta-percha, fine .. .. .. „	8/6	..
h India-rubber, Para fine .. .. „	4/10	6d. dec.
l Iron Pig (Cleveland warrants) .. per ton	49/10	2d. dec.
l „ Wire, galv. No. 8, P.O. qual. „	£14	..
g Lead, English Ingot .. .. „	£13 5 to £13 10	..
m Manganin Wire No. 28 .. .. per lb.	6/6	..
g Mercury .. .. per bot.	£8	..
d Mica (in original cases) small .. per lb.	6d. to 1s.	..
d „ „ „ medium „	2/6 to 4/-	..
d „ „ „ large .. „	4/6 to 8/6	..
p Phosphor Bronze, plain castings „	11d.	..
p „ „ rolled bars & rods „	1/0½	..
p „ „ rolled strip & sheet „	1/1	..
o Platinum .. .. per oz.	160/-	..
e Silicium Bronze Wire .. .. per lb.	8¼d.	..
r Steel Magnet, in bars .. .. per ton	£55	..
g Tin, Block (English) .. .. „	£180 to £181	..
n „ Wire, Nos. 1 to 16 .. .. per lb.	2/-	..
p White Anti-friction Metals .. per ton	£45 to £150	..
k Zinc, Sh's (Vieille Montagne bnd.) „	£29 15	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

City and South London Railway Co. — The accounts for the half-year ended December 31st last show a balance, after providing for the debenture stock interest, the payment of the dividend on the 5 per cent. preference stocks, and the transfer to the renewal fund of £1,500, sufficient to allow the payment of a dividend on the consolidated ordinary stock at the rate of 1¾ per cent. per annum, carrying forward £1,788. For the corresponding period of the previous year, the dividend was at the same rate, and £712 was carried forward.

Reduction of Capital.—THE NEW GUTTA-PERCHA CO., LTD.—In the Chancery Division on Saturday last, Mr. Justice Swinfen Eady confirmed the resolution of this company to reduce its capital, but by £69,000, not £75,000. It was mentioned by counsel that the company were now in a position to turn out cables and wires fully coated and ready to be used by electrical companies.

British Columbia Electric Railway Co., Ltd.— The board has declared a dividend of 5 per cent. per annum on the preferred ordinary shares for the half-year ended December 31st, and an additional dividend of 1 per cent. per annum.

STOCKS AND SHARES.

Tuesday Afternoon.

THE strength of Consols and of other gilt-edged stocks is a cheerful influence to the markets at large. Accompanied as it is by improvement in business of the investment order, the general tendency round the Stock Exchange is rapidly becoming more hopeful, and regaining the optimism that was a little dashed by the extremely quiet—not to say dull—manner in which the New Year started.

Holders of electricity supply shares will note with gratification that last week's advance in prices has gone still further, and that the tone is quite good. A very slight demand suffices to harden values. Several of the leading shares are better, as, for example, City of London Preference, Westminster Ordinary, Metropolitan Ordinary and South Londons. It may possibly be that the electric supply department has reached the end of its prolonged depression, and is at last on the mend again, although after the weary experience of the past few years, one speaks cautiously in regard to the prospects of material improvement.

The advance in Metropolitan Electric shares is substantial, and due to the promotion of a Bill by the company giving powers for the purchase of the undertaking of the Acton Urban District Council.

Latin-Canadian issues, too, are mostly steady to good. Mexican Light and Power Preferred is 2 up. Mexico Trams first Debentures at 98½ are 1¼ to the good, and the Sixes have hardended to 101½. Rio Trams at 104½ are *ex* 1¼ dividend, and the dividends have also been deducted from the common shares of the Mexico Tramways and the Mexican Light and Power Companies. Sao Paulo Trams are hard at 155 ; the 5 per cent. first Debenture bonds are quoted at 102 middle. Canadian General Electric Common is firm at 109, and the 7 per cent. Preference at 120, while Shawinigan Water and Power capital stock has been done at 112, with several transactions marked in the 4½ per cent. Perpetual Debenture on the basis of 103. Electrical Development of Ontario 5 per cent. bonds at 83 are again ½ higher.

Metropolitan Railway Consolidated is, for the time being, one of the liveliest stocks in the Home Railway Market, interest having been fanned by the expectation of to-day's dividend announcement. The comparison runs against 1 per cent. a year ago and ½ per cent. 12 months prior to that, therefore, the present declaration of 1½ per cent., making 2⅜ per cent. for the year, is an important step forward. Electrical development receives £10,000, and £9,500 is carried to the new account. Districts have gone ahead as well, while City and South London Ordinary rose 1½, and its period of undue neglect has been broken by sudden recognition of the stock's attraction. The dividend at the rate of 1¾ per cent. is the same as that of a year ago. The anomaly of this dividend-paying stock being quoted at the same price as Districts is a matter that received attention several times here, and the movement this week has gone only a little way towards rectifying the position.

Central London Deferred rose 1. East Londons went back to 4.

Anglo-Argentine Trams first Preference rallied slightly, and part of the dividend deductions from British Columbia Electric Railway stocks has been recovered. British Electric Tractions firmed up as regards the Ordinary shares and the two Debenture stocks. There is a good deal of activity in Metropolitan Electric Trams, the Ordinary and Deferred shares showing 1/16 rise each, and the Debenture stock being a point harder. When recently recommending Metropolitan Tramways Deferred as useful to lock up at the bagatelle price of a florin or half-a-crown, we hardly expected that a rise would come so soon as it has done. The present price of 3s. 3d. should be improved upon still further unless the public interest in these cheap tramway shares comes to an abrupt end.

In the Telegraph Market the movements are mostly in the upward direction, but, on the whole, unimportant. The investor is evidently bent on buying stock here, as in other of the more solid markets round the House, but he does not feel inclined to give more than the current quotations, and after the rise which has already occurred during the past few weeks, prices are quietly firm. Anglo-American Telegraph issues have hardly changed in spite of the proximity of the dividend announcement. American Telephone and Telegraph stock has gained another point at 147. Cuba Telegraphs are a shade up, and West India and Panama Ordinary are quoted higher at £2. The demand for good Debenture stocks has had its effect in advances in several directions, the movements varying from ¼ to 1 per cent.

The announcement by the Marconi Wireless Telegraph Company as to its agreement with the German undertaking has not affected the price of the shares.

National Telephone Deferred slipped back a point, but the 3½ per cent. Debenture has hardened to 99. Chili Telephones, *ex* 3s. dividend, are marked ½ lower, and in other telephone descriptions there is practically no change.

Amongst the manufacturing companies, Castner-Kellner Ordinary shares rose 1/16 further, after their substantial improvement of last week, but Babcocks turned a shade easier. Electric Constructions are harder, and there is ½ rise in Henley's Ordinary. Telegraph Constructions put on 10s., and Underground Electric Railway prior lien bonds have made a further improvement on account of the excellent showings which are being made by the traffic receipts of the various lines connected with the concern. The *contretemps* on Sunday last, when the failure of the power at Chelsea left the whole system in a state of suspended animation for a few seconds, was regarded more as a joke than anything else.

Montreal Light and Power capital Stock has risen 11¼ points to 154 on the declaration of a quarterly dividend of 2 per cent., that is, at the rate of 8 per cent. per annum.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1907.	1908.	1909.	1910.	Closing Quotations Jan. 10th.	Closing Quotations Jan. 17th.	Business done week ended Jan. 17th, 1911. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	5⅝ — 6¼	5⅝ — 6¼	..	..	..	Nil.
286,500	Do. 5 % Deb. Red. Iss. at 98 % script all paid	Stock	5 %	5 %	5 %	5 %	96 — 98	96 — 98	96½	96½	..	5 2 0
$355,196,000	American Telephone & Telegraph, Cap Stock ..	$100	8 %	8 %	8 %	..	145 —147	146 —148	..	..	+1	5 8 1
$58,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	4 4 3
558,460	Anglo-American Telegraph	Stock	3¼%	£3 4s.	3⅜%	..	71 — 73	71 — 73	71½	71½	..	4 19 4
3,220,770	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	..	114 —116	114½ —115½	115½	114½	..	5 3 0
3,220,770	Do. do. do. Deferred	Stock	1 %	8/-	25/-	..	28⅜ — 28⅝	28½ — 28⅝	28 1/16	28⅛	— 3/16	4 6 11
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	7 — 7¼	6⅞ — 7 1/16 xd	7	..	..	5 11 4
2,449,176	Commercial Cable, Stlng. 500 year 4% Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	84 — 86	84⅛ — 86⅛	86⅛	85⅝	+ ⅛	4 12 6
16,000	Cuba Telegraph	10	6 %	6 %	6 %	..	8⅝ — 9⅛	8⅝ — 9⅛	..	..	+ ⅛	6 6 4
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	..	16½ — 17¼	16½ — 17¼	..	..	..	5 16 9
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	3⅝ — 3¾	3⅝ — 3¾	..	..	..	4 17 10
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10%	8¼ — 8⅝	8¼ — 8⅝	..	..	..	5 14 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
60,710	Direct United States Cable	20	4½%	4½%	4 %	..	15⅞ — 16⅜	15⅞ — 16⅜	16 7/16	16	..	4 17 10
4,000,000	Direct W. India Cable, 4½% Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
2,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	135 —138	134 —137 xd	136	134	..	5 2 2
1,896,706	Do. 3½ % Pref. Stock..	100	3½%	3½%	3½%	3½%	84 — 86	83½ — 85½ xd	85½	85½	..	4 1 10
300,000	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	99½ —101½	100 —102	101⅜	101	+ ⅛	3 18 5
752,400	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	..	12 — 13	12⅞ — 13⅜ xd	13 3/16	12⅞	..	5 6 8
200,000	Do. 4 % Deb. Stock..	Stock	4 %	4 %	4 %	4 %	100 —102	100 —102	101½	101	..	3 18 5
181,127	{East. & S. Afric. Tel., 4 % Mt. Db. Mauritius Sub.) 1 to 8,000}	25	4 %	4 %	4 %	4 %	99½ —101½	100 —102	..	..	+ ½	3 18 5
181,127	Globe Telegraph and Trust	10	5¾%	5¾%	5¾%	..	10⅛ — 10⅜	10⅜ — 10⅝	10 1/16	10⅛	..	5 9 5
150,000	Do. do. 6 % Pref.	10	6 %	6 %	6 %	..	13⅛ — 13⅜	13⅜ — 13⅝	13 3/8	13 5/8	..	4 8 1
17,000	Great Northern Telegraph, of Copenhagen..	10	20 %	18 %	18 %	..	31½ — 32½	31⅝ — 32⅝	31⅝	31½	..	5 10 9
$41,380,400	Indo-European Telegraph	25	13 %	13 %	13 %	..	53 — 55	54 — 56	..	..	+ ½	5 17 0
$50,000,000	Mackay Companies Common	$100	4 %	4 %	4½%	..	93 — 96	94 — 97	..	..	+1	4 7 8
394,190	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	77 — 79	77 — 79	..	..	..	5 1 3
72,680	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	3/16 — 3/8	1/16 — 3/16	15/-	14/-	..	Nil
86,492	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	..	1/8 — 1/4	1/8 — 1/4	19/6	19/-	..	6 0 0
2,225,000	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	5 %	29/32 — 31/32	29/32 — 31/32	..	..	..	5 11 1
3,725,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	..	106¼ —107⅛	106¾ —107⅛	106⅞	106⅞	..	5 11 10
15,000	Do. do. Def. Stock	100	6 %	6 %	6 %	..	128 —130	127 —129	128⅝	127	—1	4 13 0
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	..	10⅛ — 10⅞	10⅛ — 10⅞	..	..	..	5 10 4
250,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	..	10⅛ — 10⅜	10⅛ — 10⅜	..	..	..	5 10 4
2,000,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	..	5½ — 5⅝	5⅝ — 5⅞	5 15/32	5⅛	..	4 7 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	97⅝ — 99½	98 —100	98⅝	..	+ ⅛	3 10 0
1,983,593	Do. do. 4 % Deb. Stock Red... ..	100	4 %	4 %	4 %	4 %	98 —100	98 —100	98⅝	98⅝	..	4 0 0
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid..	1	8 %	8 %	8 %	..	1⅜ — 1 11/16	1⅜ — 1 11/16	33/1½	..	..	4 14 10
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1 3/16 — 1 5/16	1 3/16 — 1 5/16	..	..	..	4 7 3
195,955	Do. do. do. 4 % Red. Deb. Stock..	100	4 %	4 %	4 %	4 %	87 — 89	87 — 89	88½	..	..	4 9 11
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..	4 0 10
11,889	Reuter's	8	5 %	5 %	5 %	..	7½ — 8	7½ — 8	7¾	..	..	5 0 0
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	96½ — 98½	96½ — 98½	97⅝	..	..	4 11 5
3,042	Submarine Cables Trust..	Cert.	6 %	6 %	6 %	..	132 —135	132 —135	..	..	..	4 8 11
120,000	United River Plate Telephone	5	8 %	8 %	8 %	..	7 7/16 — 7 7/16	7 7/16 — 7 7/16	7 7/32	7¼	..	5 6 8
40,000	Do. 5% Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5½ — 5⅝	5½ — 5⅝	..	..	..	4 6 11
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	2½%	2½%	2½%	..	1¼ — 1⅜	1¼ — 1⅜	..	..	..	4 3 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..	4 0 10
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	..	13½ — 14	13⅛ — 13⅝	13 15/16	13⅜	..	4 17 5
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 3
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	1⅞ — 2	2 — 2⅛	41/3	37/9	+ ⅛	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	9½ — 10½	9⅜ — 10½	10 1/16	9⅛	..	5 17 1
4,669	Do. do. 6 % Cum. 2nd Pref.	10	£2 6	15 %	14½%	..	8½ — 9¼	8½ — 9¼	8⅞	..	..	6 9 9
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	100 —102	100 —102	102	..	..	4 18 10

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	{Anglo-Argentine Trams, 5% Cum. 1st Pref. 1 to 640,000}	5	..	..	5 %	..	4⅜ — 5	4 1/16 — 5 1/16	100/-	96/3	+ 1/16	4 19 3
800,000	Do. 5 % 2nd Pref., 800,000 to 1,800,000	5	..	..	5 %	..	4⅞ — 4 15/16	4⅞ — 4 15/16	89/4½	..	..	5 6 8
4,465,674	Do. 4 % Deb. Stock	Stock	..	4 %	4 %	4 %	91 — 93	91 — 93	92½	91½	..	4 6 0
332,337	Auckland E. Trams, 5 % 1st Mort Deb. Stock ..	100	5 %	5 %	5 %	5 %	101½ —103½	101½ —103½	103½	..	..	4 16 7
330,000	Babcock & Wilcox, 1 to 330,000	1	20 %	20 %	24 %	..	5⅜ — 5¾	5 9/16 — 5 13/16	5⅝	5 9/16	— 1/16	4 3 1
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	..	1⅜ — 1½	1⅜ — 1½	..	..	..	4 0 0
1,000,000	British Aluminium 5 % Mort. Debs. Red.	100	..	..	..	..	..	..	..	..	..	5 8 1
500,000	British Columbia E. Rail Def. Ord. Stock ..	100	8 %	8 %	8 %	..	145 —148	145 —148	148	146½	..	4 13 9
400,000	Do. Pref. Ord. Stock	100	5 %	6 %	6 %	..	125 —128	126 —130	129	127½	+1½	4 12 4
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	..	111 —114	109 —112 xd	112	110½	..	4 9 3
238,000	Do. 4½ % 1st Mort. Deb., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
212,600	Do. 4½ % Vancouver Power Debs., 1 to 2,900	100	4½%	4½%	4½%	4½%	102 —105	101 —104 xd	..	..	..	4 6 7
133,301	British Electric Traction	10	Nil	Nil	Nil	..	1⅛ — 1⅜	1⅛ — 1⅜	32/3	28/1½	+ ⅛	Nil
161,437	Do. do. 6 % Cum. Pref.	10	3 %	1½%	Nil	..	3⅝ — 4⅛	3⅝ — 4⅛	88/9	75/-	..	Nil
1,473,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	90 — 94	91 — 95	93	91	+1	5 5 3
528,986	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	72 — 77	73 — 78	..	..	+1	5 15 5
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	..	6⅞ — 7¼	6⅞ — 7¼	..	..	..	6 17 11
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	5⅝ — 6¼	5⅝ — 6¼	6 1/16	..	..	4 16 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red..	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
201,579	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
400,000	{British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 75,000}	5	Nil	Nil	Nil	..	⅛ — ¼	⅛ — ¼	..	..	..	Nil
1,816,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	57 — 60	57 — 60	57½	..	..	6 13 4
50,000	‡Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	..	9/16 — 11/16	9/16 — 11/16	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	..	0 — ⅛	0 — ⅛	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref.. ..	2	Nil	Nil	Nil	..	0 — ⅛	0 — ⅛	..	..	..	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	37 — 42	37 — 42	..	..	..	10 14 4
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	21 — 25	21 — 25	..	..	..	18 0 0
197,610	Calcutta Trams, 1 to 137,610	5	6 %	4½%	4½%	..	4⅜ — 5	4⅜ — 5⅛	5 7/8	5⅛	+ ⅛	4 5 9
45,304	Do. 5 % Cum. Pref., Nos. 1 to 29,330..	5	5 %	5 %	5 %	..	4⅜ — 5	4⅜ — 5	98/9	..	..	5 0 0
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99 xd	96 — 99	..	..	..	4 10 11
85,000	Callender's Cable Construction shares	5	15 %	15 %	10 %	..	9⅛ — 9⅜	9⅛ — 9⅜	9⅜	9⅛	..	5 3 3
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	4 15/16 — 5 1/16	4 15/16 — 5 1/16	..	..	..	4 18 9
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
491,222	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	..	3/16 — 3/8	1/16 — 3/16	9/0	9/4½	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	12 %	12½%	17½%	..	3⅜ — 3 5/16	3⅜ — 3⅜	64/10½	66/6	+ 1/16	5 3 8
210,153	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4 %	4½%	4½%	105 —108	105 —108	..	..	..	4 3 4
1,890,690	Central London Railway, Ord. Stock	Stock	3 %	3½%	3 %	..	63 — 65	64 — 66	65	64½	+1	4 10 11
554,655	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	..	85 — 87	85 — 87	..	..	+1	4 12 0
554,655	Do. do. Def. do.	Stock	2 %	2½%	2 %	..	45 — 47	46 — 48	47	..	+1	4 3 4
1,480,000	City and South London Railway	Stock	2¾%	1¼%	1¾%	1½%	28½ — 29½	29½ — 30½	30⅜	29½	+1	4 18 4
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..	..	Nil
100,000	{Do. 5 % 1st Mort. Reg. Debs., 900 of £100, and 901 11,000 of £50 Red}	..	5 %	5 %	5 %	5 %	70 — 80	70 — 80	..	..	..	6 0 5

* Unless otherwise stated, all shares are fully paid.

‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Jan. 10th.	Closing Quotations Jan. 17th.	Business done week ended Jan. 17th, 1911.		Rise + or Fall —	Present Yield per cent.
		*	1907.	1908.	1909.	1910.			Highest	Lowest		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	6 %	5 %	..	18— 15/16	18— 15/16	19/9	..	..	5 6 8
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	..	6 0 0
271,080	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	..	12½— 13½	12¾— 13½	..	..	..	4 8 11
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	2½%	Nil	Nil	..	0 — 1/8	0 — 1/8	..	..	..	Nil
17,139	Do. "A" shares, 01—017,139	5	2½%	Nil	Nil	..	1 — 1¼	1 — 1¼	..	..	..	Nil
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	61 — 66	61 — 66	..	..	..	6 1 3
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	77 — 80	77 — 80	..	..	..	6 5 0
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	..	1/16— 1/8	1/16— 1/8	..	..	+ 1/16	Nil
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	7 %	7 %	7 %	..	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	+ 1/16	7 8 5
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	8 — 8½	8 — 8½	..	..	..	5 17 8
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	80 — 84	80 — 84	..	..	..	4 15 3
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	½%	Nil	Nil	..	¾ — 1	¾ — 1	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10¼ — 10½	10¼ — 10½	..	..	..	6 10 3
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103½	102 —103½	..	..	..	4 16 10
40,000	Henley's (W.T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	..	12¼— 12¾	12⅜— 12⅝	12⅝	..	+ ⅛	5 18 6
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	..	5 — 5⅛	5 — 5⅛	..	..	..	5 4 8
150,000	Do. do. 4½ % Mort. Deb Stock	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	..	..	..	4 5 9
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10 %	10 %	10 %	..	15 — 15⅝	15½— 16	..	..	+ ½	6 5 0
37,500	†Liverpool Overhead Railway, Ord.	10	½%	Nil	Nil	..	1⅛— 1¼	1⅛— 1¼	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	..	6⅞— 7¼	6⅞— 7¼	..	..	..	6 15 7
600,070	London United Trams. (1901) 1 to 50,007	10	3 %	Nil	Nil	..	1⅛— 2⅛	1⅛— 2⅛	..	..	..	Nil
399,930	Do. do. 50,008 to 100,000	10	3 %	Nil	Nil	..	1⅛— 2⅛	1⅛— 2⅛	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	33/8%	Nil	..	1⅝— 2⅛	1⅝— 2⅛	40/-	..	..	..
1,649,980	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	65 — 69	65 — 69	66½	..	..	5 15 11
5,782,062	Metropolitan Consolidated	100	½%	½%	1 %	1½%	40⅜— 41½	42¼— 42⅝	43⅜	40⅝	+1⅛	2 12 9
2,640,914	Do. Surplus Lands	100	2½%	2½%	2½%	2½%	64 — 66	64 — 66	65½	64½	..	4 3 4
3,235,000	Do. District	100	Nil	Nil	Nil	..	26⅜— 27½	27⅞— 28¼	28⅛	26⅝	+1	Nil
391,337	Metropolitan Electric Trams., Ord.	1	..	4½%	5%	..	¼ — ⅜	⅛ — 1	18/-	17/-	+ ⅛	5 0 0
314,016	Do. do. Defd.	1	Nil	Nil	..	..	1/16— 1/8	3/16— 1/4	3/3	3/-	+ 1/16	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	1/16— 1/8	3/16— 1/4	18/9	18/-	+ 1/16	5 0 0
595,600	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	..	99 —101	100 —102	101	100½	+1	4 8 3
$10,823,200	Mexico Trams Co., Common Stock	..	..	..	6 %	..	125 —127	123½—125½ xd	124⅜	..	—1½	4 15 7
$9,000,000	Do. 1st Mort. 50-year 5 % Gld. Bds.	..	..	5 %	5 %	..	96⅜— 97⅜	98⅛— 99½	98⅜	97⅜	+1⅛	5 0 9
245,500	Potteries Electric Traction	1	4 %	Nil	..	..	1/16— 1/8	1/16— 1/8	..	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	3/16— 1/4	3/16— 1/4	..	..	..	7 5 5
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	80 — 83	80 — 83	82	..	..	5 8 5
37,350	Telegraph Construction and Maintenance	12	17½%	15 %	17½%	..	32 — 40	38½— 40½	39⅝	38½	+ ½	5 1 10
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	99½—101½	99½—101½	..	..	..	3 18 10
1,000,000	Underground Electric Railway, 5 % Prior Lien	..	..	5 %	..	..	101½—102½	102½—103½	103	102½	+1	4 16 7
2,800,000	Do. do. 4½ % Bonds	..	..	4½%	4½%	..	94 — 96	95 — 97	95½	94½	+1	4 12 9
4,900,000	Do. do. 6 % Income Bonds	..	..	..	..	..	38 — 40	39 — 41	40⅝	39½	+1	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	10 %	5 %	Nil	..	⅜ — ½	⅜ — ½	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	6 %	3 %	..	1 — 1⅛	1 — 1⅛	..	..	..	10 0 0
245,495	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	55 — 65	55 — 65	..	..	..	6 3 1

ELECTRICITY SUPPLY COMPANIES.

30,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	..	6⅞— 7⅛	6⅞— 7⅛	7⅛	7 1/16	..	6 15 7
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	6¾— 7⅛	6¾— 7⅛	..	..	..	4 14 11
400,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	98 —102	99 —103	100½	..	+1	3 17 8
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	..	3⅝— 4⅛	3⅝— 4⅛	..	..	..	5 19 5
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	..	4⅛— 4⅝	4⅛— 4⅝	..	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	..	3⅝— 4⅛	3⅝— 4⅛	..	..	..	5 7 6
445,786	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
49,486	Chelsea Electricity Supply, Ord.	5	4½%	4½%	4½%	..	3½— 3⅝	3¾— 3⅞	..	..	..	6 0 0
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	98 —100	98 —100	..	..	..	4 10 0
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	7 %	..	11⅛— 11⅞	11⅛— 11⅞	11⅝	11⅛	+ ⅛	6 0 5
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	..	11½— 12½	12 — 13	12 1/16	12⅜	+ ⅛	4 12 4
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	118 —122	118 —122	..	..	..	4 2 0
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½%	4½%	4½%	4½%	98 —101	99 —102	101	100½	+1	4 8 3
50,000	County of Durham Electrical Power, Ord.	5	2 %	Nil	Nil	..	1½— 2	1½— 2	..	..	..	Nil
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	..	2⅜— 3⅛	2⅜— 3⅛	..	..	..	7 16 10
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	5 %	5 %	5 %	92 — 94	92 — 94	..	..	..	5 6 5
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	..	7⅜— 7⅞	7½— 7¾	7½	..	— ⅛	6 9 0
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	..	10½— 11	10½— 11	10⅝	..	..	5 9 1
400,000	Do. do. 4½ % Deb. Stock	Stock	4½%	4½%	4½%	4½%	104 —107	104 —107	105¾	105	..	4 4 1
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares	5	Nil	Nil	Nil	..	⅝— ¾	⅝— ¾	7/8	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	Nil	Nil	Nil	..	1⅛— 2	1⅛— 2	..	..	..	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	74 — 77	72 — 75 xd	75	..	..	6 0 0
$8,150,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	5 %	5 %	..	81½— 83½	82 — 84	83½	83	+ ½	5 19 1
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	..	4½— 4⅝	4½— 4⅝	..	..	..	5 12 10
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	..	4⅝— 5⅛	4⅝— 5⅛	..	..	..	4 11 11
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
15,000	Hove, 1 to 15,000	5	8½%	8½%	8½%	..	6⅝— 7⅛	6⅝— 7⅛	..	..	..	5 19 4
$1,376,000	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	5 %	5 %	..	101 —103	101 —103	101½	101⅛	..	4 17 1
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	8 %	8 %	..	6¾— 7	6¾— 6¾	..	..	— ¼	5 18 6
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	93 — 95	93 — 95	102½	..	..	4 4 3
11,000	London Electric Supply Corporation, Limited, Ord.	3	2½%	3 %	2 %	..	1⅜— 1⅝	1⅜— 1⅝	..	..	..	3 2 9
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	..	4¼— 5⅛	4⅛— 5⅛	5⅛	..	..	5 17 1
382,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4½%	4 %	4 %	4 %	89 — 92	90 — 93	..	..	+1	4 6 0
200,000	Metropolitan Electric Supply, 1 to 100,000	5	6⅔%	5 %	5 %	..	3⅜— 3⅞	3⅜— 4⅜	32/6	71/10½	+ ½	5 14 3
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	..	4⅛— 4⅜	4⅛— 4⅜	83/1½	82/6	— ⅛	4 12 4
235,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
248,000	Do. 3¼ % Mort. Deben. Stock Redem.	Stock	3¼%	3¼%	3¼%	3¼%	82 — 85	82 — 85	..	..	..	4 1 5
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	5 %	86⅜— 87⅞	87½— 88⅛	88⅛	87⅛	+1	5 13 0
13,585,000	Do. Light and Power Co., Ltd., Common	$100	4 %	3¼%	4 %	..	88⅜— 90⅜	87⅜— 89⅛ xd	89⅛	88⅝	..	4 9 5
$2,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	7 %	7 %	..	105⅜—107⅜	107⅛—109⅜	109	107⅛	+2	6 7 10
12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	100	..	5 %	5 %	5 %	94⅛— 95⅜	95⅛— 96⅛	96¼	95¼	+ ⅜	5 3 11
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..	4 11 10
180,491	Newcastle-on-Tyne, 1 to 137,500	5	8 %	2½%	..	..	3⅜— 4⅛	3⅜— 4⅛	..	..	..	2 12 9
137,500	Do. 5 % Pref., 1 to 137,500	5	5 %	5 %	5 %	..	4⅜— 4⅝	4⅜— 4⅝	..	..	..	5 2 7
150,000	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,500	100	..	..	5 %	..	97⅞— 99½	97⅞— 99½	..	..	..	5 0 6
10,852	Notting Hill Electric Lighting	10	7½%	7 %	..	..	11⅛— 12⅛	11⅜— 12⅛	..	..	..	5 12 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 ..	7 %	..	6¼— 6⅝	6¼— 6⅝	..	..	..	5 3 8
119,694	River Plate Elcty. Co. Ord.	Stock	6 %	8 %	9 %	..	228 —238	228—238	..	..	..	3 15 8
100,000	Do. do. 6% Non Cum. Pref.	Stock	6 %	6 %	6 %	..	103 —113	103—113	..	..	..	5 6 2
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	101 —103	101¾—103¾	..	..	+ ⅛	4 16 7
40,000	St. James' and Pall Mall Electric Light, Ord.	5	10 %	10 %	10 %	..	7¼— 7⅞	7⅛— 8	7 11/16	..	+ ¼	6 5 0
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	..	6¾— 7⅛	6¾— 7⅛	..	..	..	4 0 6
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	85 — 87	85 — 87	..	..	..	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	..	..	1½— 2	1½— 2	..	..	..	Nil
65,000	South London Electric Supply, Ord.	4	4 %	5 %	5 %	..	2½— 3½	3 — 3⅜	63/9	63/9	+ ½	5 19 5
130,100	Do. do. 5 % 1st Mort. Deb.	100	..	5 %	5 %	5 %	97½—100½	97½—100½	..	..	..	4 19 6
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	..	..	⅜ — ½	⅜ — ½	..	..	..	Nil
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	..	1⅝— 1⅞	1⅝— 1⅞	..	..	..	6 16 7
224,520	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	..	..	¾ — 1	¾ — 1	..	..	..	20 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	..	..	1⅜— 2⅛	1⅜— 2⅛	..	..	..	11 2 0
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	80 — 83	80 — 83	..	..	..	5 8 5
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000	1	..	5 %	..	..	⅜ — ⅞	⅜ — ⅞	15/3⅛	15/-	..	5 14 3
100,000	Westminster Electric Supply, Ord.	5	10 %	10 %	10 %	..	7⅞— 8	7⅞— 8⅛	8⅛	7⅞	+ ⅛	6 2 2
51,279	Do. do. 4½ % Cum. Pref. (Reduced from 5% since 31st Dec., 1905)	5	4½%	4½%	4½%	..	5 — 5⅛	5 — 5⅛	..	..	..	4 3 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4½ per cent. December 1st, 1910.

THE LAHMEYER CONSTANT-CURRENT DYNAMO.

FOR certain purposes, such as train lighting, searchlight work, electric welding, &c., it is of considerable advantage to employ what are called constant-current dynamos, *i.e.*, dynamos which, in spite of a large speed variation, or a large variation in external resistance, maintain a practically constant current. The arrangement devised by Herr M. Osnos for this purpose, and adopted by the Felten and Guilleaume-Lahmeyerwerke A.G., is shown diagrammatically in fig. 1. Here a_1 a_2 are the main brushes of the machine, b_1 b_2 are auxiliary brushes at 90 electrical degrees to the former (*i.e.*, 90 actual degrees in the two-pole diagram adopted), z_3 is a compensating winding carrying the main current. This is not absolutely necessary, but serves as a convenient method of adjusting the cross flux produced by the main current in the armature. Another component determining the value of this armature cross flux is the independent exciting winding z_4 supplied by some constant external source, such as a battery, and acting in opposition to the armature cross field. The main field f_1 of the machine is produced by the coils z_1 z_1 connected between the auxiliary brushes b_1 b_2, and the main brushes as shown. The voltage across these coils, and the exciting current in them, depends only on the amount of the net armature cross flux resulting from the combined action of z_3 z_4, and the armature cross ampere-turns. It will be clear from the diagram that the machine is practically a shunt dynamo (z_1 being the shunt winding), in the shunt circuit of which an opposing voltage (b_1 b_2) proportional to the resultant cross field is introduced.

If the external resistance on such a machine is reduced, the armature main current tends to rise. This rise increases the armature cross ampere-turns, and so increases the resultant cross ampere-turns, which is the difference between the constant excitation z_4 and the armature cross ampere-turns. This increase in cross field increases the voltage b_1 b_2, and so reduces the main field excitation z_1. Consequently a very small rise in external current can be made to reduce the main field (and the main volts a_1 a_2) so as to stop any further rise in current. By suitable adjustment of the separate excitation z_4, and of the regulating resistance in z_1, the current obtained on short circuit can be made equal to, less than, or greater than the current with normal terminal volts. The adjustment generally desired is that for constant current with from normal volts to short circuit (0 volts). If the value of the constant current at which the machine works is to be altered, it is not necessary to vary the separate excitation z_4 or the main excitation z_1, but simply to vary the effect of the compensating winding z_3 (by short-circuiting or cutting out some of its turns or by shunting current from it), until the ampere-turns produced in it with the new current flowing are the same as its ampere-turns with the old current. The voltage from which the current commences to be constant will now be the same with the new current as with the old, and the characteristic curves will be similar.

A set of curves obtained in this way, by varying z_3, on a 12-KW. dynamo used for a 150-ampere searchlight is shown in fig. 2. This machine ran at 2,100 R.P.M., and it will be seen (Curve 2) that the current only varied some 10 per cent. from 60 volts to 40 volts across the arc (155 amperes to 166 amperes). No regulating resistance was used with the arc, and a wide variation of brightness could be obtained by simply lengthening the arc. This method of regulating, besides its improved efficiency, has the advantage of steadier burning, because the current density in the arc is practically constant and only its length is varied.

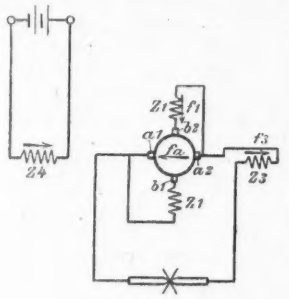


FIG. 1.

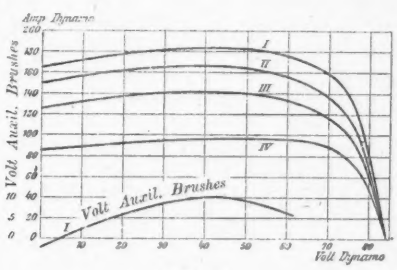


FIG. 2.

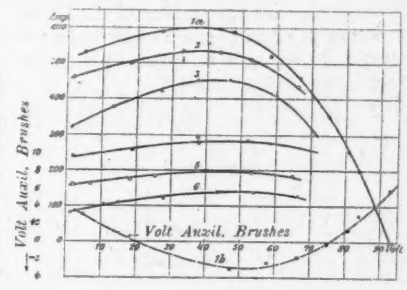


FIG. 3.

Fig. 2 also shows the auxiliary brush voltage, and it will be seen that whilst this voltage acts against the main voltage in the exciting circuit z_1 during most of the working period, it reverses and acts with the main voltage just before short circuit.

Fig. 3 shows the best result obtained on a 30-KW. dynamo used for arc welding. The speed was 1,000 R.P.M., and the normal output 65 V., 460 a., the open circuit voltage being 93, as shown in Curve 1A. By adjusting the compensating winding z_3, the machine could be set for any current down to about 180 a. (Curves 2, 3, 4 and 5), and still lower constant currents (130 amperes, Curve 6) can be obtained by weakening the separately excited field z_4.

This arrangement of constant-current machine is especially applicable to motor-generator sets, and in these it is advantageous to put the auxiliary brushes and winding on the motor instead of on the dynamo. This arrangement is shown in fig. 4, where a_1 a_2 are the main motor brushes connected to the supply, b_1 b_2 are auxiliary brushes at right angles to the others and their voltage (just as in fig. 1) is determined by the difference between a constant excitation z_4, connected to the supply, and an excitation dependent on the main dynamo current in z_3, z_6 is the motor main exciting winding, z_5 is a compensating winding for the motor armature reaction. It is not necessary to compensate the motor armature reaction exactly, as it behaves more or less in the same way as the main current in the dynamo, and can, therefore, take the place of part of z_3. The brushes b_1 b_2 are connected directly to the dynamo exciting winding z_1. The dynamo is now a normal machine, excited from an outside source, whose voltage falls off as the dynamo current increases.

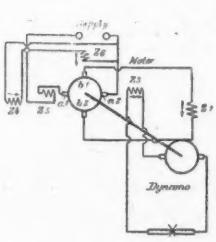


FIG. 4.

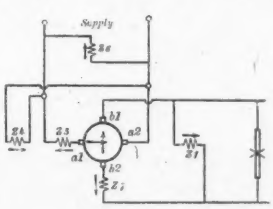


FIG. 5.

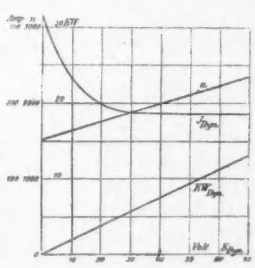


FIG. 6.

A simplification of this motor-generator arrangement has been patented by the Lahmeyer Co., and is shown in fig. 5. Here a single armature motor-generator is employed, and the brushes b_1 b_2 become the main dynamo brushes, whilst a_1 a_2 are the main motor brushes. By over-compensating

the motor armature reaction by means of z_5, the winding z_3 can be omitted. z_6 is the motor main exciting winding again, the effect of the dynamo armature reaction in the b_1 b_2 axis being compensated by z_7. The dynamo main excitation is the resultant of the constant excitation z_4, z_1, z_8, and the motor armature reaction in the axis a_1 a_2.

By adjusting the motor compensating winding z_7, the effect of the main dynamo current on the motor field, and therefore on the speed, can be varied.

Fig. 6 shows the test results obtained with a 12-KW. single-armature motor-generator connected as in fig. 5. It will be seen that with the adjustment adopted here, the speed rose from 1,500 R.P.M. on short circuit, to about 2,350 at 70 volts. The current only varied some 14 per cent. between 15 volts and 70 volts. The rather sudden rise of current towards short-circuit is unimportant in this case, because it was found that with the carbons of the lamp in contact, and the full current of 220 amperes passing, a voltage of 15 was necessary. In order to save floor space on board ship, these motor-generators are usually arranged with vertical spindles.—*E.T.Z.*

THE BAYONET SOCKET LAMPHOLDER.

[COMMUNICATED.]

THE insularity of the British nation is expressed in a good many curious forms, but it is rather a pity that in engineering, at any rate, that which has been should be persisted in without reference to its intrinsic qualities, simply because a change requires the overcoming of a little inertia. This is more especially the case when British practice is in opposition to that of the majority of other engineering nations, as it places us in an unenviable position of isolation. The metric system, as opposed to the British scheme of measurements, is a well-known example; another instance, smaller, but still of very great importance to English electrical engineers, is the use of the bayonet-socket form of lampholder.

A glance at the practice of every other nation will show that we are absolutely alone among the manufacturing nations in the use of the bayonet-socket holder. The Americans, the Germans, the Dutch—all large manufacturers of electric incandescent lamps—use the screw socket, and it is not too much to say that this variation from otherwise universal practice has placed the British manufacturers at a considerable disadvantage with his rivals as regards, at any rate, the export trade.

It is difficult to see where the advantage of the bayonet socket type of holder comes in. In manufacturing cost we have the production of plungers, springs, plunger sockets, and case, involving complicated and expensive machine shop practice, as opposed to parts which can be simply produced out of stamped or spun metal. There is no inherent advantage in the design of the bayonet socket over the screw socket; a good screw socket gives quite as good contact and reliability as the best bayonet connections, while a cheap bayonet socket is every bit as bad as the common forms of screw sockets. Moreover, it is now generally recognised that the method of connecting wires to the bayonet socket is so full of danger that special internal insulation has had to be devised; attempts have been made to do away with the cord grip for flexibles in which both wires enter the case at the same opening, and special flame-proof grips have been devised for flexible wires to be fixed above the lampholder to prevent the travel along the braid and insulation of any flame set up by the fusing of the conductors at the point where they enter the lampholder.

The situation was bad enough when lampholders were only used for supporting and connecting incandescent lamps designed to give the maximum amount of light and the minimum amount of heat. Now, however, that glow lamps of large size, run at dull redness, are used to radiate heat, the position has become still more intolerable. In the first place, the bayonet socket only gives the most insecure mechanical support, to the radiator tubes when they are held, as is the usual practice in radiators, in a vertically upward position. So much is this the case, that, in many designs of radiators, spring grips or other devices are employed to hold the tubes in position. A comparison between this and the mechanical grip afforded by the screw contact is too obvious to require comment. But, in addition to this, there is the fact that the large amount of heat developed in a radiator has demonstrated the unreliability of the bayonet socket lampholder as regards fire risks. There is probably no device which more certainly exposes conductors, closely packed together and insulated by inflammable materials capable of melting under heat, to a temperature which they were obviously never intended to stand.

That this statement is by no means in excess of the facts may be shown by the record of an incident that happened not long ago on the mains of one of the largest electricity supply authorities in Great Britain. One of the houses in a residential district had adopted electric lighting and heating in a very generous manner, using a lavish metal-filament lamp installation and luminous radiators for heating. One evening while visitors were being entertained, the lights in the drawing room went out. Investigation showed that the hall light was out, and time was taken up in trying other lights on the ground floor. It was then concluded that the service fuse had blown, but before telephoning to the supply authority it was decided to see if the upstairs lights were all right. On going into one of the bedrooms it was found that the flexible lead from a radiator was well alight for a distance of about 6 in. from the radiator. Immediately in front of it, for the purpose of airing, were articles of apparel. The floor on which the radiator stood was heavily carpeted: not 3 ft. away stood the bed with its usual hangings. Not the slightest smell of burning india-rubber had penetrated downstairs, and if the almost accidental idea of going upstairs had not occurred to one of the company, the whole house would have been alight in a few minutes.

It is this class of incident which gives rise to the reflection that a radical alteration is required in the English design of lampholders. It is useless blaming flexible wire: flexible wire is, and will continue to be, used for certain purposes, and under certain conditions it is quite safe. The risk mainly lies at the terminal points of the flexible, and it is here that attention must be given.

NOTES ON THE POSITION IN SOUTH AMERICA.

(*Continued from page* 79.)

Japan and the South American "Treasure House."

AN American Consul at Yokohama, in a recent report attributes to the chief of the Japanese Mercantile Marine Bureau some interesting remarks concerning the position of affairs in South America "as a treasure house of natural wealth." Looking to the future, he says that when the Panama Canal is completed, and the union of Atlantic and Pacific is accomplished, Atlantic coast civilisation will gradually extend to the Pacific shores, and with the whole continent under the influence of this civilisation, South America will be in a position to enter into the race for the world's commerce, and all the world's eyes will be turned toward it. He adds: "Japan must sooner or later come to realise that South America is the economic market place for her products. In ready access to the eastern shores of this wonderful land at the present moment, when the Panama Canal is completed Japan's commercial forces must capture the western shores also, and open the path to industrial and commercial expansion in this region."

The "German Credit" System.

Reverting to the growing German custom of allowing lengthy credits in this field to which allusion was made earlier in these notes, it may be of interest to mention the extent to which our Teutonic

friends are going in this connection in their efforts to secure export business. In Algeria whence we send a large quantity of agricultural machinery and Germany very little (1909 figures—933 tons from Great Britain and Canada, 37 tons from Germany), their agents are, in the case of well-known houses, granting credit up to 12 months. This is said to be the most powerful feature in their campaign which, remarks a U.S.A. Consul, "may be heeded in time, since every dealer in Algeria is obliged to give credit to his customers." The representatives who go armed with this advantage are said to speak French well, are thoroughly versed in the matters of freights, insurance, duties, and other entrance charges, the subsequent cartage, &c., and offer the dealer an inclusive price for the machine delivered to him in his warehouse. From South America to Algeria, and thence to British India, may sound a strange excursion, but we mention the last named here, as a place where the same principle is greatly in vogue. A Bombay Consular agent, reporting to America on this phase of competition, emphasises the fact that manufacturers who demand payment for goods at time of exportation—as many Americans are known to do—place themselves under a very serious handicap. "The native importer objects to paying for his goods four or five months in advance of the receipt of his order, but is perfectly willing to pay for credit accommodation in proportion to the time granted." While the German possesses the reputation of granting long credits in India, however, he only does so "when he has a thoroughly reliable agent on the spot to look after the collection." "Credit can be extended with practically no risk if manufacturers deal through an approved local European importing house." "A good many of these houses have in their employ a guarantee broker, who, before an order is accepted, carefully investigates the standing of the firm, and if this proves satisfactory, assumes entire responsibility for the payment of the goods upon delivery. For this service he receives about 1 per cent. of the value of the goods. This question of arranging credits in such a way as to be on a perfectly safe basis is of such importance to manufacturers who desire to extend their trade to India as to be worthy of their serious attention, for it is obvious that, in lines of merchandise where keen competition exists, other things being equal, the importer is going to give his order to the manufacturer who offers him the easiest terms." The failure of American firms to establish facilities for properly looking after credits, is stated to lose them considerable orders for electric lighting material and supplies. In Russia we have had striking evidence of the long-credit willingness of Germany, and yet farther East, in China, the British Commercial Attaché at Peking has felt it his duty to advise our people of the tendency and the evil result attending the lack of it on the part of British firms. It was said, for instance, that in almost every city in China there was an electric lighting project, the only difficulty being to find funds for carrying such projects into execution. "Almost all contracts are required to be financed by the contractors, and British firms, finding British manufacturers unwilling to supply plant except for cash down have sometimes co-operated with German firms, the latter arranging the finance in return for being allowed to participate. Thus, several of the contracts mentioned above are for British engines and boilers and German dynamos. Payment is generally *spread over a period of two or three years* on proper security being given."

Ordinarily Twelve Months.

In another report an American Consular agent in Russia makes the following remarks bearing upon the same question :—

As the strongest competitors of the United States grant credits to large and reliable concerns, it would perhaps pay the manufacturers at home to look into that subject more carefully than they have in the past, in order to increase their sales, especially in those sections where the European manufacturers are getting a strong foothold. To the Russian, cash payments at New York involve many inconveniences in trade, and furthermore, require large amounts of capital to remain idle in the American banks. On the other hand, our strongest competitors extend to well-rated firms almost unlimited credits, ordinarily 12 months, which are increased as new purchases are made, or causes in delay of payment satisfactorily explained.

As reaching the highest limit probably to which the German credit system has so far gone, let us quote an American Consular representative at Warsaw :—

Money-lending : Up to Six Years at 5 per cent.

In August, 1910, the Machine Manufacturing Co., of Kolomna (Kolomenskoe Machinnostroitelnoe Obshestvo), near Moscow, opened an agency in this city, which is authorised to grant credits up to six years to responsible firms, of 40 per cent. of the amount purchased at 5 per cent. interest.

This company had for many years unsuccessfully endeavoured to compete in this market. Since the establishment of the agency many orders have been received, including the entire equipment for two beet-sugar factories. I am credibly informed that the agency is authorised to extend credits up to 12,000,000 rubles ($6,180,000), and that the principal stockholder is the St. Petersburg International Commercial Bank.

This company manufactures locomotives, rolling stock, portable engines, Diesel oil engines, Guldner gas engines, suction plants, Prof. Riche patent steamboats, all kinds of steel, iron, and copper castings, steam engines, steam pumps, bridges, sugar-factory plants, draining systems, electric tramcars, turntables, steam boilers, machines for peat manufacture, and all kinds of agricultural tools and implements, and employs about 20,000 men. Its principal factories are at Golutvin in the Government of Moscow, at Riazan, and at Kulebski in the Government of Nizhni Novgorod. The company has recently purchased the factory of "Robotnik" in Riazan. It has a yearly turnover of over 27,000,000 rubles ($13,905,000).

This shows the necessity of extending credits and the establishment of agencies competent to pass upon the responsibility of the purchasers.

Canada Ready, too.

It is reported in the Daily Press that the Canadian Government is so impressed with the prospects in the Argentine that it has named a special Trade Commissioner for looking after business in that Republic. "Mr. H. R. Pousette, now Canadian Free Trade Commissioner at Durban, is to be transferred to Buenos Ayres. He understands Spanish, and is well acquainted with the trade. Mr. John H. Chesley, Trade Commissioner at Cape Town, will be transferred to Durban, and will be given charge of Canada's trade interests in South Africa."

British Trade with Brazil.

The Austrian Consul at Sao Paulo in his recent report on the trade of his district, makes some interesting comments on methods of doing business in Brazil. He states that above all in cases where catalogues are sent to Brazil and offers are made, it is essential that they should be drawn up in the language of the country, *i.e.*, Portuguese, as German, English, and even French, catalogues are little heeded.

Especially should catalogues not be printed in Spanish, as Brazilian merchants very easily recognise this as evidence of an ignorance of the real language of the country. Prospectuses with illustrations and reports as to works and supplies already effected have little result, as only the price, competition and capability to deliver have any real importance to the buyer. Prices may be quoted in English pounds sterling, francs or marks, the merchants in Brazil being quite capable of making any calculations necessary in these currencies. Moreover, prices should be quoted c.i.f. Santos; the German merchants always quote in this way. The greatest possible care should be taken in packing and marking goods, and exporters should strictly adhere to the wishes of their customers in these matters. Incorrect marking of the consignment often results in heavy Customs fines being imposed, and if such fines are once levied, there can be no refund; the Customs authorities to whom a great share of fines paid falls are very watchful to find cases on which they can impose fines for their own benefit. Disagreements with firms in Brazil should be privately settled, if possible; legal actions are extremely expensive, the lawyers being in a position to demand fees often very much higher than the case in question warrants. Terms of payment in which business is done, are 90 days after receipt of the goods in Santos. Large firms often give longer credit, in some cases 6 months, 9 months, and even 12 months. Payments against documents is very rare. Before executing orders, exporters should take care to inquire into the standing of the firm with which they propose to do business, particularly in the case of the smaller, little-known firms. Direct business in the interior of the States, with transit through Santos or Sao Paulo, is not to be recommended, and in many cases it is extremely dangerous. Consular officers can only intervene, with great difficulty, in matters of recovery of debts from firms in the interior, and even when they can, such intervention has, as a rule, little result. The terms of contracts should be strictly adhered to, especially in the case of season goods, as otherwise deliveries are valueless to merchants in Brazil, and orders will in other cases be given elsewhere. It is, as a rule, not worth while to send a traveller specialising in one line, the amount of business to be done being too small to warrant the expenses of such a course: it would be much better for firms in separate lines to send out one traveller, and to share the expenses of the trip. Unless business is done through the large trading houses, it is very necessary that firms desirous of doing business should be supplied with a capable representative holding a stock, if possible.

The Advice of the British Consul at Rio de Janeiro.

In a recent report on the trade of Brazil, the Secretary of H.M. Legation at Rio de Janeiro states that it is necessary to emphasise the advisability of furnishing catalogues in Portuguese.

Prices when so high that shillings are not of importance may be given in pounds sterling. When fractions of £1 come in, it would be well to express them as decimals of £1. Shillings and pence are not readily understood, and this difficulty often causes catalogues to be consigned to the waste-paper basket. One milreis gold equals 2s. 3d., and 1 milreis paper about 1s. 4d. Dimensions should be expressed in the metric system, except in the few industries where British and American goods predominate so greatly that yards, feet and inches are solely used. The tendency in most Brazilian cities is to do business verbally rather than by writing or by telephone. British firms sending representatives to Brazil should choose men with a thorough knowledge of the goods they offer, in order to be able to discuss such goods in a technical manner with the foreman or manager, or those who know the business. A good knowledge of Portuguese is invaluable, but where this is not possible a competent interpreter should be secured. His charge would be about £1 per day and expenses. It appears to be a popular notion that Spanish is the second business language of Brazil, but, as a matter of fact, Spanish is probably not so much used by Brazilians as English or French.

Competitions for Contracts.—Later in the report it is stated that the Budget Law for 1910 contains the following rules to be observed in open competitions for contracts with the Federal Government either for the supply of material or for a public service.

1. The question of the status or suitability of the tenderers shall be decided before the tenders are opened. The proposals of tenderers not judged to be suitable shall not be opened.

2. If the Government desire to reserve to themselves the right to annul any competition in case the prices quoted are too high, they shall declare beforehand the highest price which will be taken into consideration.

3. The proposals shall be opened and read in the presence of all the tenderers who come forward to assist at this formality. Each one will countersign those of all the others which will be published in full before the decision is given.

4. The call for tenders shall indicate minutely the technical and administrative conditions (plans, designs, nature of the construction and material to be used, maximum period for the commencement and completion of the work, &c.). In the case of supplies which cannot be exactly designated, samples of what are required shall be deposited in the Government Departments.

The competition will be decided on the price of the unit of the whole of the work, of the lease or furnishing according to the terms of the call for tenders.

5. The proposals shall only contain a formula of complete acceptance of the conditions laid down in the call for tenders and the price quoted by the tenderers. No consideration will be given to offers of advantages not foreseen in the call for tenders, nor to proposals merely containing an offer of a reduction on the cheapest tender.

6. The contract shall be awarded of right to the tenderer putting in the lowest tender, however small the difference between it and another.

7. The Government can lay down a second condition in case of the absolute equality between two proposals, in order to obtain a better classification.

(To be continued.)

PROCEEDINGS OF INSTITUTIONS.

Röntgen Society.

AT the meeting of the Röntgen Society on January 5th, a lecture was delivered by Prof. E. Rutherford on the radio-activity of thorium, with special reference to the work of the last five years by Otto Hahn and Rutherford and Soddy upon the highly-concentrated and radio-active products of this substance. Prof. Rutherford said that it was now some years since the inconstancy of radiation of some thorium compounds was traced back to the presence of a radio-active gas or emanation. It was now discovered that this thorium emanation, although disappearing within a few minutes, was capable of giving an active deposit, which, on analysis, was found to consist of four substances. These four substances—which were named thorium A, B, C and D—arose successively, each transformation being accompanied by the expulsion of the alpha particle. None of them were permanent. The longest-lived was thorium A, half of its atoms being transferred or breaking up in 10·6 hours, half of the remainder in 10·6 hours, and so on, and this periodicity governed the rate of disappearance of the active deposit as a whole. Thorium D, the latest addition to the thorium family, emitted beta and gamma rays. Although the activity of a plate covered with this deposit, falling to half value in 10·6 hours, would finally disappear within a few days, the possibility of getting exceedingly radio-active plates, the activity of which should thus last usefully for a day or two, was a practical consideration.

Prof. Rutherford then turned to the substances derived from the transformation of thorium itself, apart from its emanation. He dealt in turn with thorium X, which was easily separated by precipitating thorium by ammonia, and which fell to half-value in 3·6 days; radio-thorium, which lost half of its activity in two years, and, finally, meso-thorium, situated intermediately between thorium and radio-thorium, and having a period of 5·5 years before decaying to half-value. Although radio-thorium could not be separated directly from thorium, the meso-thorium could be separated quite easily. It had beta and gamma radiation, but emitted no alpha rays. In course of time, however, it would "grow" into radio-thorium, which possessed alpha radiation, and its activity would thus increase. Although if it were kept away from its spontaneously appearing family of products it would, as stated, decline to half value in 5·5 years, yet if it were considered in relation to the transformations which would ordinarily take place, its activity would rise for 3·5 years after its separation, when it would be from one and a half times to twice as great as it was initially. It would then die away with time, but even after ten years its activity—or, rather, the activity of the transforming substance—would be higher than it was when the simple meso-thorium was first separated.

This subject had an interesting commercial bearing. A great amount of thorium—some seven hundred tons annually—had to be produced for commercial purposes, and this made it easier to secure the preparation of this very intense radio-active matter. The labour of extraction was certainly greater than in the extraction of radium. Nevertheless, they could anticipate the production of very large quantities of these active substances because thorium was wanted commercially, and, once obtained, these active substances could be separated without any effect upon the commercial application itself, and without injuring the product or appreciably wasting the substance in the manufacturing process. The price would probably be much lower than the present price of radium. The meso-thorium preparations could be standardised, and, moreover, in the separated meso-thorium they had the small proportion of radium which was present in the monazite sand where the thorium was found. For ordinary medical purposes, meso-thorium was quite as good as radium. It gave beta rays of the same penetrating power and gamma rays of perhaps even greater penetrating power, and he believed that this substance, and indeed, the whole gamut of thorium radio-activity, would assume considerable importance in the future.

Institute of Marine Engineers.

AT the Institute of Marine Engineers, on Monday, January 9th, adjourned discussions took place on the papers by Mr. Jules Lecoche on "Electromagnetic Transmission for Main Marine Propulsion," and by Mr. W. P. Durtnall on "The Internal Combustion Engine."

In the course of his reply MR. LECOCHE said that the heat generated from hysteresis could not be more in his system than the heat generated in an alternator. He had often run a magnetic worm and wheel out of synchronism for as long as 15 minutes without the slightest increase in temperature. The gear did not act as a brake. As soon as both engines were out of synchronism they were entirely independent of each other until they synchronised again. It was impossible to make a mechanical worm gear to reduce the speed from 3,000 to 75 revolutions per minute, having a gear efficiency of more than 70 per cent. The efficiency of the magnetic gear was well above 90 per cent.

MR. W. P. DURTNALL stated that he understood the machine described by Mr. Lecoche had been tested, and had given excellent results; but as it was of very small dimensions, it would not be right to assume that it would act equally satisfactorily with a large installation. He hardly thought it possible to attain 90 per cent. efficiency with electromagnetic transmission, because of the fact that the whole action of the "draw" or "pull" forming the torque took place at one point on the periphery of the wheel. He thought the machine would work very well as a speed-reducing gear but not as a power transmitter. For marine propulsion the gear must be designed for constant running at full load, and he would like some particulars as to the heating effect allowed for in relation to the weight of the gear.

MR. G. L. JONES said the maximum lock between the rotary and the stationary portions evidently occurred when they synchronised, and he did not see how the rotation was to be started unless by external power.

In opening the discussion on Mr. Durtnall's paper, the CHAIRMAN (Mr. W. McLaren) stated that the economical aspect was the main one in relation to the proposal to adopt the internal-combustion engine for marine purposes. One difficulty would be in obtaining the requisite speed of the engine to suit the propeller, and the question of propeller design would necessarily be involved.

MR. E. SHACKLETON said the oil-engine makers had made a reversing engine because of the demand for reversibility, although, in the majority of cases, he thought they would have preferred an intermediate electrical drive. He did not think shipowners were at present inclined to the adoption of electrical driving, but, personally, he thought it the best system for reversing and manœuvring. With regard to thermal efficiency, that of the Diesel engine was 38 per cent., and the gas engine 20 to 25 per cent., as against the 12 to 14 per cent. of the steam engine.

MR. W. ARNOLD referred to the statement made at a previous discussion, that the two-stroke engine was now as economical as the four-stroke, and questioned whether it could be substantiated.

MR. F. M. TIMPSON said the makers of two-stroke paraffin engines gave a guarantee of ·6 of a pint as the fuel consumption per B.H.P. per hour, while that of the makers of the four-stroke type was ·75. These were actual results, although they only applied to small powers up to about 100 H.P., and for the larger powers this class of fuel would doubtless not be so suitable.

MR. G. L. JONES said an important point was the comparative initial cost of the internal combustion engine, also the cost of upkeep. In central station work there was a large ratio in favour of the turbine. The large amount for expenses, lubricating oil, repairs, &c., in the internal combustion engine were to be considered.

MR. W. P. DURTNALL cited a case of a 500-H.P. four-cylinder engine running on gas produced from crude oil, in which the average consumption, including auxiliaries, amounted to ·9 lb. per B.H.P. per hour. He thought provision would have to be made for using coal as well as oil. The engine for marine propulsion would have to be designed to use the cheapest form of crude oil.

The discussion was adjourned till Monday, February 13th.

Switchgear and the Isolation of Faults on Power Supply Systems.

By H. W. CLOTHIER.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *at Newcastle, December 19th*, 1910.)

THE primary considerations governing the design of successful automatic switchgear are :—

A thorough understanding of the functions which the apparatus has to perform ;

A rigid elimination of unnecessary parts ; and

A construction affording maximum security with minimum supervision and maintenance.

In the design of a large high-tension power system, the whole of the plant must be so arranged that failure of an individual part due to accidental injury shall not affect the supply to a single consumer. This condition calls for the instantaneous isolation of faulty parts, and such an arrangement of parts as to avoid breakdown of one affecting another. The only practical way to attain these objects is to sub-divide the generating, transmitting and transforming plant, so that, in the event of failure of one sub-section, the remainder will have sufficient overload capacity to continue the service, each sub-station being controlled by automatic switchgear inserted at the junction points between it and others.

In order to provide against a shut-down to the entire system, the network should be split up into a number of self-contained areas, interconnected in such a way that they can be automatically divided on the occurrence of a bad fault without seriously affecting the distribution of the load.

The automatic switchgear should not rely solely for its successful operation on a particular lay-out or feature in the lay-out of the plant ; it is better first to determine the most economical lay-out of the plant and then to provide switchgear to suit. As ordinarily one cable is cheaper than two for the same service, duplicate cables over the same route should be avoided, except when the load is larger than can be dealt with by the most economical size of cable. The network, therefore, includes ring mains, and in order that the copper shall be used to the best advantage, each ring is closed : thus there are no idle cables. The closed ring main provides a supply to each sub-station along duplicate routes, and a suitable protective system ensures the automatic isolation of any single cable without interrupting the supply to the sub-stations.

The requirements of switchgear, considered from a protection point of view, may be stated as follows :—

Reliable automatic operation under fault conditions.

Inoperative, whatever the condition of the load, while the section which it protects is sound.

Freedom from risks of shocks and burns.

Freedom from breakdown under all working conditions.

Reduction of cleaning, testing and supervision to a minimum.

Robustness of construction to withstand all kinds of rough usage and to eliminate fire risks.

Ready access to those parts where regular inspection is unavoidable, and

Protection against shock, by the automatic isolation of such parts before it is possible to handle them.

It is a common practice to install the various parts forming the switchboard inside cubicles constructed of cement or brickwork, thus providing fireproof divisions between the bus-bars and the remaining apparatus. Such apparatus has the advantage of having its parts readily accessible, but usually it calls for cleaning at frequent intervals, and, sooner or later, someone is apt to begin work on a live panel, with serious results. It has also the disadvantage of occupying a large amount of room and involving expensive building construction.

The principal features controlling the mechanical construction of the switchgear are—bus-bars, circuit-breaker, and the discriminating devices operating it. There is little variety in the construction of the bus-bars, and the choice of a circuit-breaker is practically confined to an oil-break switch. The types of discriminating device which have been most generally used are overload devices and reverse-current devices, but so far the most satisfactory discriminating device which has been tried on a large scale and found to operate with certainty when required and to remain inoperative when not required, is the "Merz-Price" system of balance protective gear.

The use of graded time limits in series has had an extensive trial as a discriminating system, but unfortunately this system has often failed on important high-tension transmission networks. It cannot be used on a ring main, it is opposed to the principles of instantaneous release, and it is difficult, if not impossible, to predetermine the correct settings of relays at various positions on the system in order to isolate with certainty a faulty section without shutting down any of the healthy ones—*i.e.*, it lacks discrimination.

Reverse-current devices have been tried and have also been found wanting, the principal difficulty being to make them inoperative when faults occur on sections other than those which they are intended to protect. They are also useless as a means of protection in situations such as ring mains, where the flow of power may reverse under normal conditions.

In the system of balance protection the criterion of operation is that, while a section is sound, the current entering it must be identical with that leaving it (excluding a very small amount due to capacity).

Three methods of connecting this system have been adopted—E.M.F. balance, current balance and neutral wire balance.

In the first, the balance is obtained by having the E.M.F. at the secondary terminals of the current transformers in opposition, that is to say, under normal conditions no current flows through the pilot wire.

In current balancing, under normal conditions, current flows through the pilot system in direct proportion to the main current.

In the third system, the secondaries of the transformers are connected as for current balance, the neutral wire connecting points of equal potential at the two ends of the section ; in this case, under normal conditions, no current passes through the pilot system on which the relays are connected.

In some cases it is desirable to supplement the balance gear with devices for protection against sustained overloads. With current balancing this can be obtained by merely inserting fuses in the secondary protective leads. The introduction of a time limit device applied to feeder protection with E.M.F. balancing has also been suggested.

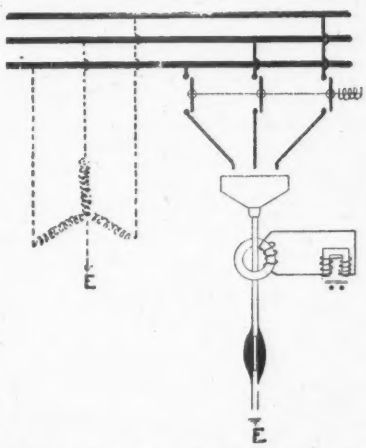


FIG. 1.—TAIL END PROTECTION ; CORE BALANCE, WITH SINGLE TRANSFORMER.

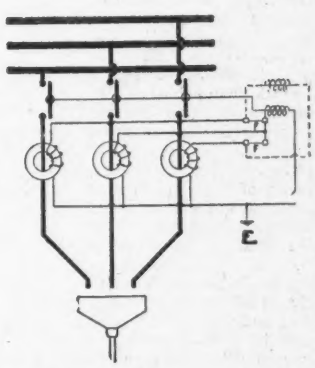


FIG. 2.—INSTANTANEOUS LEAKAGE PROTECTION, WITH TIME-LIMIT OVERHEAD RELAY ADDED.

A three-phase A.C. system having the neutral point earthed, considered from a protection point of view, forms the most suitable system, in that a fault of sufficient magnitude between either of the three phases and earth would operate the relays, and clear the faulty section before further damage is done there or elsewhere. On the other hand, protection on an insulated system is simpler ; there is one less pilot lead and a saving of one current transformer and two relays at each end.

An interesting development of the balance protective gear is a system which has been called the "core balance," or "leakage" protection (fig. 1). This system provides for the instantaneous isolation of a circuit on the occurrence of a fault or leakage to earth, and, in common with the other balance protective gear, it is inoperative on ordinary overloads ; moreover, it has the advantage that no pilot wire is required. A balance is maintained on the relay or trip coil circuit so long as the algebraical sum of the currents in the three cores of the main cable is zero. This balance however, is disturbed immediately there is a leakage to earth on one or more of the cores, and the switch is thereby tripped, provided the leakage exceeds a predetermined amount.

Time limit protection against sustained overloads or faults between phases is often added by the introduction of fuses and another trip coil (fig. 2). The use of this system is strictly limited as a means of protection against faults on high-tension networks by the fact that it only discriminates between a fault to earth and an overload ; that is, it is quite useless in its present form for ring main protection. It may, however, serve some purpose in the pro-

tection of tail ends, and for mines and places where sustained arcing is a great source of danger, the system can be applied to advantage in that it offers the possibility of cutting out a fault occasioned by a fall of rock so quickly that no arcing external to the cable can occur.

It will be understood that the balance system can be adopted for protection in a great variety of ways, see the accompanying diagrams and those in "Proceedings of Institutions" in our last issue. On a high-tension power supply system the leading considerations concern the protection of generators, feeders and transformers.

The principal generator faults to be considered are :—

1. A failing field ;
2. The failure of the prime mover ; and
3. A breakdown of insulation on the armature windings or main connections.

In some large power stations the engineers, preferring to rely upon the alertness of their operators, have no automatic protection on the generators. If, however, it be decided that some automatic protection is necessary to guard against a failing field only, a relay with a time element can be installed, which will open the main switch when a drop in excitation voltage occurs. If protection is also required against motoring or a failure of the prime mover, a reverse-power relay must be resorted to. The latter, however, must be provided with some time-element feature to prevent it from disturbing the continuity of supply by isolating its machine at times when momentary reversals occur.

The breakdown of insulation in a generator circuit is a more serious matter, as, under these conditions, not only is the supply jeopardised, but abnormal stress is put upon the conductors of the sound machines for several periods.

The ideal generator protection would isolate the faulty machine within a fraction of a cycle without interference with the other machines. The nearest approach to this ideal is obtained by the balance system of protection. The arrangement which has been adopted is shown on fig. 3 (current balancing). The fuses shown on this diagram may be used for overload protection, as previously described. The usefulness, however, of the fuse in this instance is limited, as under ordinary circumstances it would need to be set very high.

The bus-bars must be absolutely reliable in a power station, and they should be so substantial and the insulation so secure that there is no need to provide automatic protection. It can be provided with this system, but is not recommended.

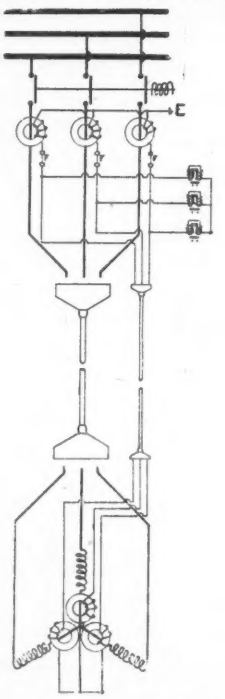


FIG. 3.—GENERATOR PROTECTION ; CURRENT BALANCE.

The simplest arrangement of connections for balance protection on feeders is E.M.F. balance—the standard arrangement adopted by the power supply undertakings in Northumberland and Durham.

The setting of the relays at various positions on the high-tension network should be determined by the amount of current possible through a fault occurring at the respective positions ; this amount varies with the resistance and inductance between the point where the fault occurs and the generating plant, and also within certain limits, with the aggregate power in the generating plants.

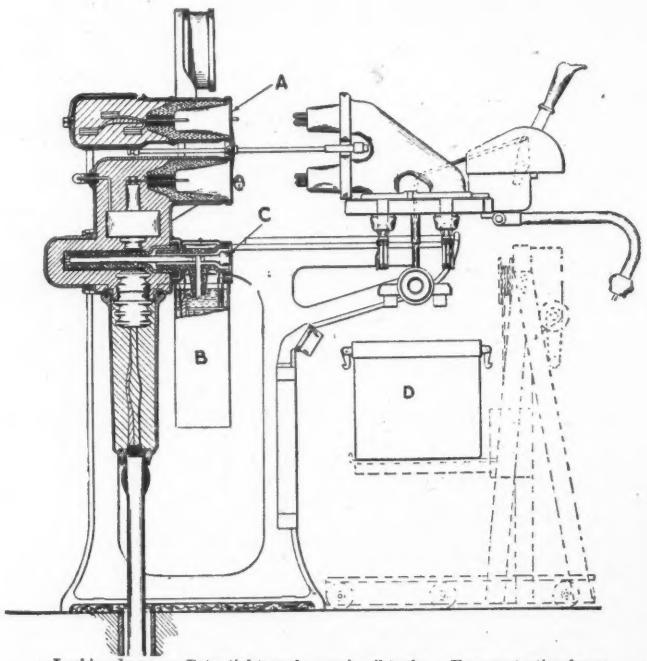
The adoption of the balance protection on a large system carries with it the necessity for sectionalising the various ring mains and interconnected network by means of overload cut-outs at certain points ; time-element overload devices are installed at the generating station end or at other sources of supply to the several areas. With an arrangement of this kind a bus-bar fault occurring in any of the areas, by bringing out the instantaneous overload devices, separates the areas and leaves the faulty one to be dealt with by the time-limit overload devices. Where a "tail-end" cable is not duplicated, the core balance or leakage system can be applied to afford instantaneous release for faults to earth and a time-element release for overloads or shorts between phases.

For the protection of transformers, current balancing is utilised. The protective current transformers can also be used for working instruments, provided, of course, that suitable provision is made to compensate for the impedance of the instrument circuits in order to preserve the balance, by having an equivalent impedance on each side of the points of connection to the relays.

Protection against a sustained overload, such as would be occasioned by a short circuit on the low tension bus-bars, can be obtained by the insertion of three fuses in the pilot leads. The difficulty due to abnormally large magnetising currents at the moment of switching in is overcome by the insertion of a small fuse in parallel with the relay.

It will be noted that efficient automatic protection throughout the various parts of a high-tension system is possible, and at the same time it has been possible to dispense with the use of potential transformers for protection, thanks to the systems advocated being operated solely by the current passing through a fault. However soundly potential transformers are constructed, they are always liable to be a weak link in switchgear equipment. Consequently in those cases where they cannot be avoided (for example, when no other source for a low-tension supply to wattmeter and voltmeter is available), it is advisable to connect them inside a protected circuit and not directly to the bus-bars ; preferably they should form a separate equipment attached through a light and reliable fuse to the main body of the switchgear. They should be readily removable, while the main conductors are alive, without the possibility of shocks to workmen, and to give additional security they should, if possible, have the main automatic oil switch between them and the bus-bar.

The irreducible minimum of equipment for an automatic switch panel fitted with balance protective gear consists of bus-bar, circuit-breaker, current transformers and relay. Any additional apparatus, however carefully designed, must add to the risk of breakdown and increase the cost of maintenance, and while all designs of switchgear must provide for the addition of voltmeters, power-factor indicators, wattmeters, &c., these should not be used on the high-tension gear unless absolutely essential. The surest way to obtain efficient protection from shocks, burns and fire is to enclose all high-tension conductors within a strong covering, so constructed that access to them while they are alive is rendered impossible. At the same time the insulators supporting, and the insulators covering the conductors, should also be enclosed in such a way that the only exposed parts of the switchgear are metal casings at earth potential.



A, Locking doors ; B, Potential transformer in oil tank ; C, Fuse protection for B ; D, Switch tank lowered for inspection.

FIG. 4.—SECTION THROUGH REYROLLE SWITCH PANEL.

To meet the foregoing requirements a type of apparatus has been evolved which may be referred to as "armoured" switchgear. A cross-section of a panel containing bus-bar, switch, transformers, and relays (*i.e.*, the aforesaid irreducible minimum for an automatic panel) is shown on fig. 4. The bus-bars are enclosed in a separate iron chamber made up in segments with band joints between each panel. The bus-bars themselves and the joints are immersed in insulating compound. The current transformers are enclosed in a separate chamber for each panel, and, like the bus-bars, are immersed in compound. These two chambers are supported on standards which form the framework of the gear.

The oil switch is of the draw-out type, as shown ; a pair of doors which are normally tucked away between the bus-bar and transformer chambers, automatically follow the switch carriage out and close over the orifices which contain the plug connections to the bus-bars and transformers respectively (A, fig. 4). Incidentally, this illustration shows an instrument in position and one arrangement adopted when the use of a potential transformer has been essential.

It is a fitting conclusion to consider briefly how the apparatus mentioned in this paper complies with the essential conditions which have been enumerated at the onset, and how it differs from other apparatus in general use :—

Reliability in the automatic isolation of a faulty section without disturbance to the sound sections has been obtained by the use of the balance system of protection, whilst older systems of protection have been uncertain in their action, failing more especially in the discriminating factor.

Freedom from shocks and burns has been obtained by the avoidance of exposed bare conductors.

Freedom from breakdown has been secured by using insulating compound as a filling medium between conductors throughout, this taking the place of air insulation in many other types.

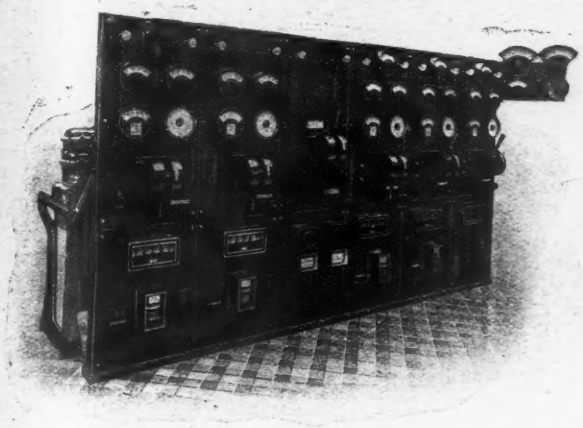


FIG. 5.—FRONT VIEW, IRONCLAD SWITCHBOARD.

The enclosure of all conductors and insulators carries with it a reduction in the maintenance work, including cleaning, inspecting, testing, &c., and also eliminates the risk of the insulation being lowered by conducting fumes, moisture, &c.

Robustness of construction is obtained by the armouring, and switchgear so constructed compares with other types of apparatus just as an armoured cable in rough service would compare with a non-armoured one.

The routine maintenance of switchgear has been confined to the switch contacts, operating mechanism, and the protective relays,

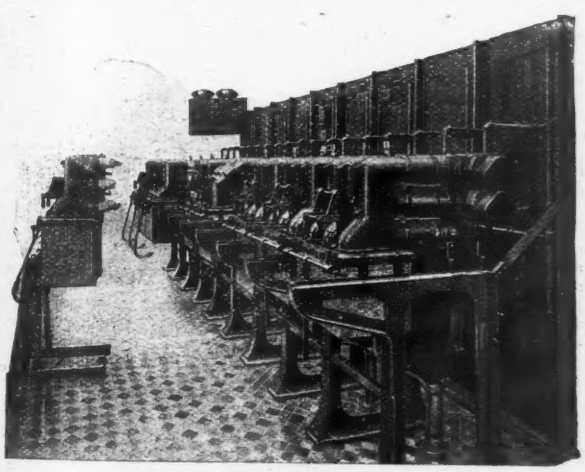


FIG. 6.—VIEW BEHIND BOARD SHOWN IN FIG. 5, ONE SWITCH UNIT WITHDRAWN.

and whereas the inspection of apparatus on some switchgear designs involves great risks, the interlocking arrangements described have furnished a means for effecting this work in safety.

The systems of balance protection described are not intended to cover the present production of any particular manufacturer, it being understood that several firms manufacture this apparatus.

DISCUSSION.

MR. WEDMORE (British Thomson-Houston Co.) emphasised the importance of considering the possible result of breakdown as a criterion in switchgear design. He distinguished between generating station and sub-station switchgear, pointing out that a fault in the latter would be cleared from the generating station end, and thus could not cause such extensive damage, whilst a serious fault in a generating station switchboard might result in the complete destruction of the switchgear, which being the most vital part in the system would produce chaos. There was consequently a serious risk attached to the concentration of switchgear in a generating station, and he considered that the universal practice of adopting the type of board, facetiously described as the warehouse type, for large generating stations was fully justified. In sub-stations and small stations where concentration of switchgear could be justified and where compactness and low cost were primary considerations, he was of opinion that the compounding system was neither necessary nor ideal. Equally compact truck type switchboards were obtainable in which every part was more accessible than in the compounded type. The cleaning bogey could be dealt with by the employment of a dust-proof construction. With an instrument transformer of the type illustrated, in the event of the secondary becoming open-circuited, the core, and consequently the insulation, would become heated and possibly seriously reduce the factor of safety; on a large plant a failure at this point would result in explosion. He considered that there was no better system than the Merz-Price system known in the art, and that there was no other reliable system in use for the protection of interconnectors and single ring mains. At the same time, on account of the cost of "Merz-Price" plant, it had been necessary to develop other types, and the relays, &c., obtainable in the present day were far superior to those known at the time when the Merz-Price scheme was adopted; such apparatus and devices were in extensive use and giving complete satisfaction. Reverse-current relays could now be obtained which would operate with great rapidity at very low voltages, and the arrangement could be made surge proof by the adoption of suitable connections.

In a written communication MR. WEDMORE added that it was held that the ring-main system and employment of single feeders should be generally adopted on the score of economy of cables; he had, however, met with a large number of instances in practice where it was found that the adoption of the ring-main system was not justified. Taking, for example, a typical case of a centrally-situated generating station surrounded by three, four or even five sub-stations, it would be found, as a rule, that the amount of cable required to furnish a duplicate supply direct from the generating station to each sub-station was materially less than would be required if single cables were so employed, and each sub-station were interconnected to its neighbour. If an extension were made on such a system to a remote point the employment of two cables following the same route would still generally be the most economical arrangement. Again, in the case of distributing power over a small area, where the location of consuming points could not be foreseen, it would often be found more economical to employ a direct duplicate supply system, especially having regard to the cost of obtaining wayleaves and of opening up two ways instead of one. The most economical route was often one which could not possibly be adopted. There was an alternative method of distribution—by dividing the cable system into two portions, A and B, coupled normally only at the generating station, switches being provided on each consumer's premises and distributing centre, arranged for taking the supply only from one system at a time. In the event of the supply failing on one feeder, the customers on that feeder would switch over to the alternative supply. The feeders would be mostly open-ended, and could thus be protected by the balanced-core system at the generating station end.

MR. W. W. WOOD (Scott & Mountain) raised a question as to the necessity of providing time-limit fuses on the relays used for feeder protection, to guard against their operating when switching-in feeders having large capacities.

MR. P. V. HUNTER (Merz & McLellan) said that a frequent source of trouble was incandescent metallic vapour bursting out of an oil switch, and causing a "short" between phases on the adjacent bus-bars. The introduction of the ironclad type of gear, however, prevented this. He did not agree with Mr. Wedmore that it was not suitable for power stations, and he thought that the reason for its not being adopted was that the demand was not great enough to cover the heavy development costs. In spite of its so-called faults the Merz-Price system saved 30-40 per cent. in mains.

MR. W. C. MOUNTAIN said that he believed in having every part of a switchgear as accessible as possible, and he objected to parts being hidden away in cubicles where there were holes and corners difficult to look after and keep clean. The objection to many protective systems, especially for colliery work, was the necessity for a fourth wire, and most of them made an earthed neutral necessary. He did not believe in this for small installations. Protective gear was useful if not overdone; he certainly objected to having the whole system in a nervous condition ready to shut down on the appearance of the slightest fault. In the case of a fault occurring on a pump circuit, for instance, it might be absolutely necessary to keep running at all costs, even if the engineer had to stand by all the time until repairs had been completed.

DR. W. THORNTON (Armstrong College) remarked on the small amount of information available on the subject of the carbonisation of oil. It was a curious fact that a fuse blowing in coal dust caused less carbonisation than breaking the same current by means of a switch.

MR. VESEY BROWN said that he preferred switchgear he could sit on, to a type he could look at but dare not touch. He thought that simplicity and rigid standardisation were of great importance especially where operators moved from one station to another.

MR. J. ANDERSON (Newcastle Electric Supply Co.) said that it was easy to imagine all sorts of trouble, but no trouble at all had arisen with the ironclad gear. A fault on the cubicle type of gear could be a very serious matter, and he remembered one which shifted some 3-in. slabs and blew out several windows. With the ironclad type the arc went to earth at once and thus localised the damage. He thought that high-tension fuses could safely be used to protect transformers up to 300 KW. capacity, and there seemed to be an opening for a combined fuse and isolating switch for work of this description. The "switching-in" current of even a 10-KW. transformer might be as much as 8 to 10 times full-load current. He considered it better to switch-in transformers from the H.T. side, as the switches were better able to stand it.

MR. F. O. HUNT said that the currents in the conductors could be compared magnetically, and a system embodying this principle had been invented by Mr. M. B. Field, of Ferranti's, Ltd. He surrounded the cable with a closed magnetic circuit, the flux in which was, of

course, zero when the three cores were carrying equal currents or when their algebraic sum amounted to zero. Any fault, however, upset the balance, and the resulting magnetic flux induced a current in the coil with which the core was wound. The apparatus could be designed sufficiently sensitive to trip an automatic switch. He might mention that all automatic gear took an appreciable time to act on account of the mass of the parts to be put into motion.

MR. C. VERNIER (Newcastle Electrical Supply Co.) asked Mr. Wedmore how he would proceed to protect a network, such as the local supply companies had. (Mr. Wedmore replied that he would "Merz-Price the lot.") He urged the importance of alternative routes for cables, and remarked upon the backwardness in this country in respect of overhead transmission. In underground cable systems great difficulty was often experienced due to a fault sealing itself up again and only re-appearing after several days. The rapidity of action of the Merz-Price system prevented shocks on the supply station, and it also prevented synchronous motors and rotaries from falling out of step. Before the introduction of the Merz-Price system in Northumberland and Durham it was a common occurrence to find large areas shut down and to find that every relay except the right one had operated. Now a small section only was shut down, and the source of the trouble could be localised immediately.

MR. G. L. PORTER (Newcastle Electrical Supply Co.) said that with the ordinary design of series transformer the secondary current rose with the primary current, and as the capacity effect on long pilots increased at the same time, the total current tending to trip the relays was not proportional to the primary current. In the case of an overhead line dropping on long grass it was difficult to get gear sufficiently sensitive to act without at the same time being liable to be affected by capacity currents. There was no need for gear having the rapidity of action of the M.P. system in sub-stations having one transformer only. In the event of a fault occurring, it was essential that the power station should hang on to the load until the faulty section had been removed, and the only way that this could be done with time-limit relays was to connect two to each circuit, one with a very large instantaneous setting and the other with a smaller time-limit setting. He suggested that generators could be amply protected by a current transformer on the neutral connected in series with suitable current transformers on each phase.

MR. CLOTHIER (in reply) said that in almost every installation the solid system was applied where possible. The cables were solid, the machine windings were as solid as possible, so why not the switchgear? Statistics were available to prove that the solid type was ahead of all others in respect of immunity from breakdown. The drawback of the cellular type was that in the event of an arc starting it generally travelled to other chambers and put neighbouring parts out of commission. The core balance system referred to in the paper was applicable only to systems having earthed neutrals. Experiments showed that an ordinary oil switch took from $\frac{1}{10}$th to $\frac{1}{10}$th of a second to break circuit, but he would like to see this shortened to $\frac{1}{100}$th of a second if possible. In reply to Mr. Wood, he stated that the rush of current on switching-in a cable was very much less than when switching-in an open-circuited transformer. In reply to Dr. Thornton, he had no experience of the use of petroleum emulsion, but with oil special attention had to be given that it was not liable to absorb moisture. Preference should be given to an oil which would still be liquid at 15° F. He agreed with Mr. Anderson that some economical arrangement was necessary for the protection of small transformers, but it must not be forgotten that the amount of power behind a fault had to be taken into account. On overhead lines it was usual to have the pilot cable lead-covered and suspended from a catenary wire. On account of the capacity effect mentioned by Mr. Porter, it had been found necessary to keep the voltage of the relay system as low as possible, and the tripping current as large as possible. The capacity effect was serious on long pilots only, and it should be borne in mind that in these cases the fault current was limited by the resistance of the main cores. In that district the relays near the generating station were set for a 500-ampere fault to earth, whereas those more remote were set for 200 amperes. Mr. Porter's suggestion for generator protection would work only on faults to earth, and, of course, any fault between phases would soon develop into a fault to earth. It had the advantage that it could be installed without disturbing the machine windings. He agreed to a certain extent with Mr. Porter's suggestion that there was no need to protect a single transformer with the M.P. system, so far as protection of itself was concerned, but it was sometimes necessary to allow a straight-through excess current to pass without tripping out, and this could hardly be done with ordinary overload protection of the same degree of sensitiveness.

Electricity in New South Wales Collieries.

By E. KILBURN SCOTT, M.I.E.E., A.M.Inst.C.E.

(Abstract of paper read before the ASSOCIATION OF MINING ELECTRICAL ENGINEERS.)

COAL was first discovered in Australia in 1787, and up to the year 1829, 50,000 tons of coal had been raised; since then the industry has progressed by leaps and bounds until, at the end of 1909, the quantity of coal raised in the State of New South Wales alone reached the total of 154,845,053 tons, valued at £59,250,850. Although New South Wales does the bulk of the trade, coal is also found in the other Australian States.

Prof. David estimates that the unworked areas of the Palæozoic coalfields of New South Wales contain 150,000,000,000 tons of coal in seams of 3 ft. thickness or over and at a depth not exceeding 4,000 ft.

All the Northern collieries have adopted direct current, the usual pressure being 250 volts. The writer believes 250 volts became standardised through the activity of the agents of American makers of coal-cutters. The motors for these have been standardised in America at that pressure.

The firm of J. & A. Brown controls a large number of pits which have hitherto been worked with compressed air. Now a large electric power house is being built and equipped with two 1,000-KW. Willans mixed-pressure steam turbines, running at 1,500 revolutions and driving Siemens three-phase alternators giving 2,300 volts at 50 periods per second.

Some of the D.C. installations are being changed over to A.C. Thus, the Aberdare collieries had direct current at 250 volts. Messrs. Scott & Mountain have recently supplied alternators to take the place of the existing dynamos, and three-phase motors to drive the dynamos as motor-generator sets, totalling 1,200 KW. At points as near as possible to the area to be worked, these motor-generators are installed to convert from three-phase at 2,200 volts to direct current at 250 volts, in order to utilise the existing direct-current motors on coal-cutters, pumps, &c.

The usual type of generating plant was an American quick-speed horizontal engine driving a dynamo by belt, but these are now being taken out and replaced by British-made quick-speed engines coupled direct to dynamos. The Belliss engine is a great favourite.

There is no doubt whatever that British makers of coal-cutters would be preferred to the American for any extension plant if only they would produce machines suitable for "room and pillar" work. One result of the Government inquiry has been to favourably dispose the colliery owners and managers to British-made plant. It is interesting to note that Messrs. Scott & Mountain are about to introduce a chain-breast machine similar to the Morgan-Gardner type referred to below.

One interesting point that the writer noticed in connection with the colliery managers in Australia was their eagerness to adopt new labour-saving appliances. It is not necessary to bring overwhelming evidence that a piece of apparatus has been used elsewhere. They will listen to the explanation, and if they can see good points in it, they will give the apparatus a trial.

A favourite method of fixing cables in New South Wales mines is to tie them on to petticoat insulators which have right angle and coach screw stalks. The stalks are screwed into the supporting timbers of main roads and headings, or where convenient they screw into wooden plugs driven into the roof.

Before the inquiry some of the cabling had been very roughly done. Thus at one colliery an insulated cable ran from the gate-end switch to a brattice cloth, and on going behind it the writer found that there were bare copper wires, and the ends of the insulated wires were simply bent and hooked over. That apparently formed the junction box and main switch. This was put in by an American on the system that he had been accustomed to in the States.

The largest installation of electric coal-cutters is at Hebburn Colliery, Maitland, where there are 17 in use. At Abermain there are 16, and at Aberdare 13, nearly all chain-breast machines.

The ordinary breast chain coal-cutter makes an undercut about 3½ ft. wide and 4½ to 6 ft. under the coal. The chain then backs out, and the machine is pinched sideways with crowbars an amount about equal to the width of the cut. The chain then cuts in again, and is withdrawn, and so on. This naturally means a good deal of hand work in setting the machine, unsetting, pinching sideways, and so on. One machine, known as the Sullivan, has been developed to overcome this.

Jeffrey coal-cutters are best known, and there are about 40 at work in New South Wales. At Hebburn there are two classes; those for the open-lamp section have open motors, which give 17 H.P., and in the safety-lamp section the motors are enclosed and give 21 H.P. The Goodman chain-breast coal-cutter is very similar to the Jeffrey. On the Goodman machine at Hebburn, the motor gives 24 H.P.

The Morgan-Gardner is a similar machine, but it has the motor on a vertical spindle, thus doing away with bevel gears.

The Sullivan machine is of the chain-breast type, but when the chain has cut into the coal it remains under. The chain is advanced under the coal at the right rib of the room, and then travels sideways, cutting as it goes, until it reaches the left rib. The coal-cutter travels across the face at from 14 in. to 24 in. per minute, according to the hardness of the coal. With ordinary chain-breast machines from 5 to 10 minutes are required to cut, move and set jacks ready for the next cut, making the progress across the face average from 4 in. to 8 in. per minute. Owing to the small space necessary for operation between the face and the props, it is also available for mines where the weakness of the roof has prohibited the use of other chain machines. The motor runs on a vertical spindle. It is altogether an excellent machine for room and pillar work, and there are quite a number at work in New South Wales.

Percussion pick machines are much used in New South Wales, and they are nearly all driven by compressed air.

At the South Bulli Colliery there is an interesting combination of electricity and compressed air. A 100-H.P. electric motor drives an air compressor which supplies an equipment of compressed-air percussion pick cutters. One of the reasons for the adoption of this system was that the bad roof in one part of the mine did not allow room for chain-breast machines. This is a method of working which the writer thinks is bound to have a great run, as it solves the difficulty of working when gas is liable to be met with. An electrically-driven percussion pick machine, called the Morgan-Gardner, is in use in New South Wales, but only to a small extent. The machine is used for entry driving, cutting

necks and turning rooms. In ordinary coal it will cut 60 ft., 4 ft. under, per shift of nine hours. It requires one skilled runner and one helper to operate it. It has a reciprocating piston, actuated by a spring and cam, the spring striking the blow and the cam drawing the piston back. The cam is in turn driven by a motor, having a vertical spindle. An important feature is the manner of connecting the commutator to the armature coils, there being no wire connection at this point.

The stroke of the piston is 8 in., and the machine gives 175 to 225 strokes per minute. The length of machine is 7 ft., width over wheel is 21 in., and the weight is 750 lb.

The bar coal-cutter as made by Messrs. Mavor & Coulson has got a good foothold in Australia.

For room and pillar working, which is much used in New South Wales, trail cables give more trouble than they do in straightforward long-wall working. For example, it is usual to carry out the fitting on self-propelled trucks, and so the trail cable is alive whilst the machine is being moved from one room to another. When the starting switch is at the "full on" position the speed may be too high for negotiating corners, and so accidents are liable to occur, such as the trail cables being run over whilst they are alive. This has happened several times. The machines are usually arranged to pull themselves on or off the trucks, and this also means the trail cables being alive.

The number of mine electricians now on the register in New South Wales is 40, and this number qualified by examination out of a total of 92 who entered.

The New South Wales rule *re* examinations provides that not only must the mine electrician have a certificate, but the assistant electrician must have one as well.

Engine drivers in New South Wales mines are also examined by the Government, and only certificated men can be employed where life is at stake.

The writer's experience in the Colonies is that an engineer has to be more resourceful there. He is on the opposite side of the world from where much of the machinery of which he has charge was made, and so, if it goes wrong, there is no such thing as sending a telegram for a fitter or winder. Further, there is seldom anyone in the district who can undertake the repair, so he just has to do it himself. The engineer met with in the Colonies is more after the old millwright type, who could do a bit of anything in the mechanical way.

One matter that will come to the front when mine electricians' certificates are granted in this country will be the question of reciprocity. Already, in the Second Report of the Royal Commission on Mines, the admission of Colonial and foreign experience and certificates for mine managers' and under-managers' certificates has been favourably commented upon. It is recommended that the Secretary of State should grant such certificates without examination to persons possessing foreign and Colonial certificates, as may be approved by him from time to time. At the present time certificates gained in Great Britain are admitted in New South Wales, whereas in Great Britain the holder of a New South Wales certificate is required to pass an examination. Of the 117 first-class certificated mine managers in New South Wales, 45 were examined in Great Britain.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

Amendments.

AUSTRALIAN COMMONWEALTH.—The Australian Customs authorities have published the following decisions regarding the duties leviable on electrical and similar goods :—

Electrical appliances, &c.—	*Per cent.*
Cell-testing apparatus, siphon, consisting of india-rubber ball, tubing and glass tube and gauge :—	
Rubber part	20
Glass part	20
Couplings, ammeter, used in connection with electric lighting	10
Drying apparatus, hair, "Fon" electric, a small electric fan with provision for heating the air	20
Electrophone, the "Stolz"	10
Plate, nipple, for cell-testing	10
Machinery.—	
Elevators, spiral, comprising a motor, spur wheel gear, and spiral staircase frame for car to ascend—	
Motor, under 200 H.P.	20
Cog wheel gearing and shafting attached... ...	20
Spiral staircase frame, including rails specially fitted for same	25
Magnetos, imported with and for motor engines. These cannot be regarded as "for use in the manufacture of engines."	20
(The Australian Customs authorities have provided for the free importation of magnetos, provided security be given by the owner that they will be used only in the manufacture within the Commonwealth, of internal combustion engines, and that proof of such use be produced to the satisfaction of the collector within six months after delivery by the Customs.)	
Massage machine, "Poso" electric. A small magneto machine operated by wheel gearing connected with external rollers	20
Telphers, electric, and material therefor, *i.e.*—	
Rails	10
Girders, not drilled or further manufactured ...	12½
" if drilled or further manufactured... ...	25
Brackets or arms, or shoes for attaching rails or girders to standards	25
Bolts and nuts, separately packed	20
Wire, copper, in ordinary commercial coils for the electrical connections	Free
Regulating, starting and controlling apparatus (electrical)	20
Switches, imported in separate shipment	Free
Telphers, complete with buckets	Free
Telphers, complete with electrical hoist and buckets	Free
Buckets, extra, without wheels	25
Buckets, extra, fitted with wheels	30
Sparking plugs	20

The Australian Customs authorised have also decided that if electrical and gas appliances are made of brasswork or gun-metal work as used for general engineering and plumbing and other trades, they will be dutiable at the rate of 25 per cent. *ad valorem*, instead of 10 per cent. *ad valorem*, as was previously the case.

Note.—The duties quoted are those under the Preferential Tariff applicable to British goods.

CUBA.—A Cuban Presidential Decree, dated November 22nd, 1910, has been issued, exempting iron wire included under paragraphs (*a*), (*b*) and (*c*) of No. 41 of the Cuban Customs Tariff from the Customs surtax of 30 per cent. imposed in 1904, provided that such wire is imported into Cuba by manufacturers for use in industries in that country, and that a sworn declaration to that effect is made by the importers. The duties on iron wire imported under the terms of this Decree will be as follows :—

41. Iron wire, galvanised or not :

	Per 100 kilogs. Dols. cts.
(*a*) More than 2 mm. in diameter ...	1 00
(*b*) More than ½ mm. but not more than 2 mm. in diameter ...	1 30
(*c*) ½ mm. or less in diameter ; and wire covered with any kind of tissue	1 60

BRITISH GUIANA.—The Customs Duties Amendment Ordinance, 1910, provides that the duty on goods not specially mentioned in the tariff be raised from 12½ per cent. *ad valorem*, with an additional duty of 5 per cent. of the amount leviable at that rate to 15 per cent. *ad valorem*, with an additional duty of 10 per cent. of the amount of duty leviable at that rate.

FRANCE.—The French Customs Authorities have decided that pulleys for transmitting power for dynamo-electric machines, if imported with the apparatus to which they belong, shall be dutiable at the same rate as dynamo-electric machines (for rates, see Electrical Review, of February 19th and 26th, 1909). If imported separately they will be dutiable at the rate of 10 francs per 100 kg., which is the rate applicable to "pulleys for transmitting power."

The Motor Boat "Paragon 1st."—On Tuesday, January 10th, at Richmond, a commander engineer and several constructional experts carried out, at the instructions of the Lords Commissioners of the Admiralty, manœuvring, steering and reversing trials on the above boat, which is fitted with the "Paragon" marine steering propeller, with excellent results in every way. The tests are of special interest to electrical engineers, as it is claimed that with this propeller the revolution speed is higher per unit of effective thrust, making the weight, cost and space lower, and the efficiency higher, than is the case in connection with the low-speed screw propeller. The whole of the patents for this invention, both British and Foreign, are owned by the "Paragon" Marine Propeller Co., London. It is claimed for this propeller that the battery power required for electric launches is about half as much for given wetted hull surface, and speed, as is required with the inefficient fast-running screw propeller, with a consequent reduction in weight and in the displacement with given load.

The Brussels Exhibition Fire.—The experts instructed by the committee of the British Section at the recent exhibition to inquire into the causes of the fire and to fix the responsibility have not been able to determine the cause. They consider that there was insufficient pressure of water, that the fire service was lacking in organisation, and that the City of Brussels ought to have at its disposal two steam fire engines, whereas it has none. The responsibility would thus appear to fall on the city.

NEW PATENTS APPLIED FOR, 1911.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

46. "Controlling mechanism of alternating-current arc lamps." A. OGILVY-WEBB, H. J. BOOKER and R. C. A. REINECKE. January 2nd.

55. "Telegraphy." P. B. DELANY. January 2nd. (Complete.)

60. "Electrical purification of gases and apparatus therefor." J. Y. JOHNSON. (Badische Anilin & Soda Fabrik, Germany.) January 2nd.

65. "Method for reducing the loss of energy in lined with variable electro-magnetic equalising." F. A. BECKER. (Convention date, January 4th, 1910, Germany.) January 2nd.

65A. "Method for reducing the loss of energy in lined with variable electro-magnetic equalising." F. A. BECKER. (Convention date, January 4th, 1910, Germany.) January 2nd.

71. "Electric water heaters." J. W. EWART. January 2nd.

72. "Contact pins for interrupters for electric circuits." Firm R. BOSCH. (Convention date, February 11th, 1910, Germany.) January 2nd. (Complete.)

76. "Electrical conductors." BRITISH THOMSON-HOUSTON CO. LTD. (General Electric Co., United States.) January 2nd.

79. "Electric cooking appliances and water-heaters." V. NIGHTINGALL. January 2nd. (Complete.)

81. "Electric regulators." H. DEITNER. January 2nd.

132. "Electric furnaces used in the manufacture of metal-filaments." G. LUDECKE and IMPERIAL LAMP WORKS (BRIMSDOWN), LTD. January 2nd. (Complete.)

142. "Electrical purification of gases and apparatus therefor." J. Y. JOHNSON. (Badische Anilin & Soda Fabrik, Germany.) January 3rd.

176. "Insulating compounds." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) January 3rd. (Complete.)

177. "Systems of electric motor-control." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co,, United States.) January 3rd. (Complete.)

178. "Electric circuit-controlling devices." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) January 3rd.

181. "Electric circuit-centre spark plug." G. C. BLICKENSDERFER. January 4th. (Complete.)

188. "Armatures for magneto-electric generators." ALBION MOTOR CAR CO., LTD., and T. B. MURRAY. January 4th.

207. "Galvanic batteries." A. HEIL. (Convention date, January 4th, 1910, Germany.) January 4th. (Complete.)

223. "Rotary field induction generators." SIEMENS BROS. DYNAMO WORKS, LTD. (Siemens-Schuckert werke G.m.b.H. Germany.) January 4th. (Complete.)

225. "Electric light attachment." J. A. WILLIAMS and G. A. GILLIES. January 4th. (Complete).

296. "Automatic electric signal system for use upon steam or electric railways." J. H. CLARK. January 5th.

303. "Electric cooking and heating apparatus." A. A. V. WILLIAMS. January 5th.

320. "Electrical contact devices." O. ENGEL. (Addition to No. 6,765/08.) January 5th. (Complete.)

325. "Sparking plugs." F. LUX. (Convention date, May 4th, 1910, Germany.) January 5th. (Complete.)

337. "Shades or globes for gas, electric light and other illuminants and means for supporting same." R. W. F. WHITEHEAD. January 5th.

348. "Electric wiring of buildings." L. MILNE. January 5th.

355. "Electric traction on elevated cable tracks." L. HEISSE and H. SCHULTE. (Divided application on 12,843/10, May 26th.) January 5th. (Complete.)

365. "Electric letter-box bell." R. J. WARIN. January 6th.

402. "Lamp globes, particularly for electric arc lamps." JOHNSON AND PHILLIPS, LTD., and J. BROCKIE. January 6th.

436. "Miners' safety lamps and igniting appliances in connection therewith, and electric dynamos, motors and switches." F. A. HAILWOOD. January 7th.

459. "Electric generating systems of vehicles, particularly for lighting up motor-cars." W. SEAL.

468. "Electrical switches." A. STEPHENSON. January 7th.

473. "Galvanic batteries." A. HEIL. (Convention date March 14th, 1910, Germany. Addition to 207/11). January 7th. (Complete.)

498. "Controlling apparatus for electric motors." OTIS ELEVATOR CO., LTD. (Otis Elevator Co., United States.) January 7th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1909.

CONTROL OF ALTERNATING-CURRENT ELECTRIC MOTORS. M. Milch. 20,743. September 10th.

ELECTRICAL METERING INSTRUMENTS. E. R. Murray. 28,947. December 10th.

ELECTRIC SUPPLY SYSTEMS FOR LIGHTING AND OTHER PURPOSES. M. A. Codd. 29,329. December 15th.

ELECTRICAL SHIP-LOG APPARATUS. Thomas Walker & Son, Ltd., T. E. Walker and T. G. Walker. 29,448. December 16th.

PREVENTION OF OVER-CHARGE OR OVER-DISCHARGE, OR OF BOTH OVER-CHARGE AND OVER-DISCHARGE, OF SECONDARY BATTERIES. B. S. Dobbie. 29,496. December 16th.

ELECTRIC CALL OR SIGNALLING APPARATUS, OR AN INSTRUMENT FOR CALLING SEPARATELY, BY MEANS OF AN ELECTRIC BELL, SEVERAL STATIONS CONNECTED BY A SINGLE WIRE. L. E. Belcourt and L. S. Lebret. 29,637. December 18th.

TELEPHONE INSTALLATIONS. Siemens Bros. & Co. and H. W. F. Ireland. 29,677. December 18th.

ELECTRIC TIME SWITCHES. H. F. Reason and Reason Manufacturing Co. 30,051. December 23rd.

JOINTING OR BINDING TOGETHER OF MEMBERS IN METAL STRUCTURES BY ELECTRIC WELDING. R. Koopman. 30,097. December 23rd.

1910.

SPARKING PLUGS. H. G. Longford. 339. January 6th.

DYNAMO-ELECTRIC MACHINES, PARTICULARLY APPLICABLE FOR IGNITION PURPOSES IN CONNECTION WITH INTERNAL-COMBUSTION ENGINES. A. H. Midgley and C. A. Vandervell. 2,525. February 1st.

TRANSMISSION FOR PETROL-ELECTRIC AND ELECTRIC VEHICLES. W. A. Stevens. 2,700. February 3rd.

SYSTEM OF ISOLATING AND FEEDING ELECTRIC CABLES AND FITTINGS FOR PORTABLE OR FIXED ELECTRIC LAMPS OR OTHER FITTING IN COAL BUNKERS, MINES, MAGAZINES, SPIRIT, PETROL, AND OTHER STORES AND PLACES, SUCH AS SHOWROOMS WHERE HIGHLY INFLAMMABLE MATERIALS ARE KEPT. F. E. Rogers. 4,066. February 18th. (Cognate application, No. 18,073 of 1910.)

MULTIPLE SWITCH DEVICES FOR ELECTRIC MOTORS. Adams Manufacturing Co. (Cutler-Hammer Manufacturing Co.) 5,279. March 2nd.

METHODS OF AND MEANS FOR CHARGING ELECTRIC RESISTANCE FURNACES. R. Petersson. 6,035. March 12th. (Date applied for under International Convention, June 2nd, 1909.)

ELECTRIC ACCUMULATORS. E. M. Gatinaud. 6,746. March 17th.

APPARATUS FOR THE ELECTRO-DEPOSITION OF METALS. T. H. Smith and T. Deakin. 7,225. March 23rd.

PROCESS AND APPARATUS FOR THE PREPARATION OF ELECTRICALLY CONDUCTING FILAMENTS. R. Madden and W. G. Housekeeper. 7,331. March 23rd. (Date applied for under International Convention, March 31st, 1909.)

TELEPHONE SWITCHBOARDS. Siemens Bros. & Co. and F. Hird. 8,551. April 8th.

ELECTRIC RESISTANCE FURNACES. A. Petersson. 8,711. April 11th. (Application for Patent of Addition to No. 6,035 of 1910.)

MERCURY CARBON-FILAMENT INCANDESCENT LAMP. S. Weber. 9,250. April 16th. (Date applied for under International Convention, October 9th, 1909.)

SPARKING PLUGS OF INTERNAL-COMBUSTION ENGINES. A. Christmas. 10,842. May 3rd.

ELECTRICALLY PROTECTED PLATES AND LININGS FOR VAULTS, SAFES, AND THE LIKE. W. Williams. 11,550. May 10th.

MAGNETO-ELECTRIC MACHINES FOR VELOCIPEDE LAMPS AND THE LIKE PURPOSES. C. Schlick. 12,524. May 23rd. (Application for Patent of Addition to No, 5,043 of 1910.)

INSTRUMENT FOR MEASURING ANGULAR MOVEMENTS OF SUBMARINE AND AERIAL VESSELS AND THE LIKE, RELATIVELY TO THE HORIZON AND MAGNETIC MERIDIAN. C. B. B. Laures. 12,746. May 23rd. (Date applied for under International Convention, June 21st, 1909.)

IGNITION MECHANISM FOR INTERNAL-COMBUSTION ENGINES. V. Rawson. 14,754. June 18th.

ELECTRIC FURNACES. J. Thomson. 15,169. June 23rd. (Date applied for under International Convention, September 1st, 1909.)

TROLLEYS OR COLLECTORS FOR ELECTRIC TRAMCARS. A. Engel. 17,380. July 23rd.

IGNITION MECHANISM. A. J. Boult. (J. Ruzicka.) 18,946. August 11th.

WARD-LEONARD SYSTEM FOR ELECTRIC MOTORS. Siemens Bros. Dynamo Works, Ltd. (Siemens-Schuckertwerke Ges.) 22,110. September 24th.

Neon Light.—M. Georges Claude, the well-known pioneer in the field of gas liquefaction, recently submitted to the French Physical Society the results of his work on neon light. The remarkable brilliancy possessed by the spectrum of that gas, and the fact discovered by Collu, that a glass tube containing neon and a mercury globule is made to shine by shaking in the dark, induced M. Claude to undertake some experiments on the possible use of the gas for lighting purposes, the more so as, according to Prof. Bouty's work, its dielectric constant is extremely low. His attempts to improve the light of mercury tubes by combustion with neon light failed to give any satisfactory results. Endeavours made to use pure neon directly as a source of light proved far more successful, though the fact that neon is liable to become polluted by minute amounts of foreign gases (mixed with it from the beginning or disengaged by the electric current from the electrodes and tube walls) presented much difficulty. These drawbacks were eventually done away with by fitting the neon tube with a carbon reservoir immersed in liquid air, where all foreign gases were absorbed.

At the recent Paris Automobile show, Claude, in conjunction with the Moore Co., installed four neon tubes, each 36 metres in length, which gave quite surprising decorative effects. As the light of these tubes is very rich in red rays, the façade of the Grand Palais seemed to be immersed in a sea of strong red light. However, in the absence of any term of comparison with other sources of light, the eye becomes used to the light with surprising rapidity, so as to receive only the impression of a remarkably warm golden yellow. In this form neon light, owing to its great economy and ease of handling, is found to be especially adapted for a multitude of technical applications.

As no accurate data on the Grand Palais installation are so far available, Claude in the meantime gives an account of the working conditions of a tube 6 metres in length and 45 mm. in diameter exhibited before the Physical Society. The potential difference between the terminals of this tube, on account of the low dielectric constant of neon, is only about 1,000 volts; as in connection with arc-like discharges, this potential difference is found to decrease somewhat with increasing current intensities, dropping from 1,100 to 980 volts as the current intensity increases from ·1 to 1 ampere. With a potential difference of 1,000 volts and a current intensity of ·94 ampere, the power consumption is found to be 850 watts, corresponding to a power factor of ·9, similar to that observed by Wedding with Moore tubes filled with nitrogen. Photometric measurements made by the Wedding process on a strip of tube several centimetres in length showed the luminous intensity to be 220 C.P. per metre, corresponding to a total of 1,320 C.P. The Carcel lamp used in this connection was found to be especially suitable because of its reddish light.

These results are bound to be considerably improved upon in longer tubes, as a considerable portion of energy is lost at the electrodes, which loss remains constant with increasing lengths of tube. As measured by means of auxiliary electrodes, it amounts to as much as 300 watts with a total power consumption of 850 watts.